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PROGRAM MANAGER FOR ROCKY MOUNTAIN ARSENAL COMMERCE CITY, COLORADO

INTERIM RESPONSE ACTION BASIN F LIQUID INCINERATION PROJECT

DRAFT HUMAN HEALTH RISK ASSESSMENT VOLUME I

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13. ABSTRACT *(Maximum 200 words)*

THIS DOCUMENT IS A COMPREHENSIVE, MULTIPLE EXPOSURE PATHWAY, HUMAN HEALTH RISK ASSESSMENT PREPARED FOR THE BASIN F LIQUID INTERIM RESPONSE ACTION. THE OBJECTIVE OF THE RISK ASSESSMENT IS TO ESTABLISH CHEMICAL EMISSION LIMITS FOR THE INCINERATION OF BASIN F LIQUIDS WHICH ARE PROTECTIVE OF HUMAN HEALTH. ALL POSSIBLE DIRECT AND INDIRECT EXPOSURE PATHWAYS AND SENSITIVE SUBPOPULATIONS WERE EXAMINED. IT WAS CONCLUDED THAT THE INCINERATION FACILITY POSES NEITHER CARCINOGENIC NOR NONCARCINOGENIC RISK TO ANY SENSITIVE POPULATION.

THE ASSESSMENT IS DIVIDED INTO THE FOLLOWING SECTIONS:

1. INCINERATION FACILITY DESCRIPTION
2. DESCRIPTION OF SURROUNDING AREA
3. PROCESS OF POLLUTANT IDENTIFICATION AND SELECTION
4. DETERMINATION OF EMISSION RATES FROM INCINERATION FACILITY
5. AIR QUALITY AND DEPOSITION MODELING ANALYSIS
6. DETERMINATION OF KEY PATHWAYS AND POLLUTANTS

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EXECUTIVE SUMMARY

INTRODUCTION

In accordance with the Federal Facility Agreement, the Department of the Army (the Army) is in the process of implementing the Basin F Liquid Interim Response Action (IRA) at the Rocky Mountain Arsenal (RMA). As part of this action, the Army has selected a proprietary incineration system to treat the Basin F liquid presently stored in three aboveground storage tanks (totaling 4 million gallons) and an engineered surface impoundment, Pond A (totaling approximately 6.5 million gallons). The incineration system is a submerged quench incinerator (SQI) developed by T-Thermal, Inc. of Conshohocken, Pennsylvania. This selection process has been documented in the Final Decision Document for the Basin F Liquid Treatment Interim Response Action (Woodward-Clyde, 1990).

Subsequently, the Army has tasked Roy F. Weston, Inc. (WESTON) to design and construct the incineration facility. As part of that assignment, WESTON has prepared this report, entitled Draft Human Health Risk Assessment - Volumes I and II, which has been written to establish risk-based numerical emission limits for the incineration facility. All supporting documentation is provided in Volume II Appendices. A summary of the numeric emission limits was included in the Draft Implementation Document (WESTON, December, 1990).

Prior to the performance of the risk assessment, a document entitled Ambient Air Quality Modeling and Health Risk Assessment Protocols was submitted by WESTON (September, 1990) to the U.S. Environmental Protection Agency (EPA) Region VIII office in Denver, Colorado, with copies sent to the Program Manager for the Rocky Mountain Arsenal. Comments were received from EPA and the Army (October 18, 1990). The comments were addressed, and a revised protocol was submitted to the Army (WESTON, December, 1990).

OBJECTIVES AND APPROACH OF THE RISK ASSESSMENT

The criteria used to establish risk-based numerical emission limits for the SQI were stated in the Final Decision Document (Woodward-Clyde, 1990) as follows:

- To be consistent with EPA guidance that CERCLA remedial actions be protective of human health and the environment, operation of the SQI facility should create no cumulative excess cancer risk higher than 1E-06 (1 in 1 million) for carcinogens, or hazard index greater than 1 for noncarcinogenic compounds, in the nearest exposed population, whether on or off the arsenal.

- Should either of these criteria be exceeded, an analysis of the contributing factors would be presented to the appropriate agencies, as outlined in the Final Decision Document (Woodward-Clyde, 1990), to determine whether a change in design would be necessary.

To accomplish these objectives, WESTON conducted a multiple exposure pathway, human health risk assessment using the following documents as general guidance:

- Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (EPA, 1989).

- Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions (EPA, 1990).

The risk assessment process consisted of the following specific steps:

- Characterization of Land Use -- On-site and off-site land and water uses were evaluated to identify:
  - Potentially-exposed populations in areas affected by incinerator emissions
  - Population activities relating to potential pathways of exposure

- Selection of Chemicals and Determination of Emission Rates -- Data from test burns, waste stream analyses, and hazardous waste emissions inventories were evaluated to estimate emission rates for:

- Principal organic hazardous constituents, including products of incomplete combustion and dioxins/furans

- Trace metals

- Criteria pollutants and acid gases

- Air Quality and Deposition Modeling Analysis -- Ambient air dispersion and deposition analyses of incinerator emissions were conducted according to conservatively modified versions of EPA-approved models (Industrial Source Complex Short-Term Model (ISCST) and UNAMAP VI version of ISCST, respectively). Isopleths were plotted to determine areas of maximum air dispersion and total (wet and dry) surface deposition for a 10-kilometer radius around the incinerator.

- Determination of Key Pollutants and Pathways -- Land and water use information, pollutant emission rate data, and air quality and deposition modeling results were integrated to determine chemical specific exposure pathways of concern for adults, children and infants.

    - Air pathway -

        -- Inhalation

    - Soil pathway -

        -- Dermal absorption
        -- Soil/Dust ingestion
        -- Vegetable consumption
        -- Milk consumption
        -- Beef consumption

- Surface water pathway

    - fish consumption

    - drinking water consumption

- Breast milk consumption

- Exposure Assessment -- Average and maximum lifetime daily intakes were calculated for adults, children, and infants in four maximum exposure scenarios under base case (average expected) and sensitivity case (reasonable worst case) emissions condition. Figure ES-1 illustrates specific pathways evaluated for each scenario.

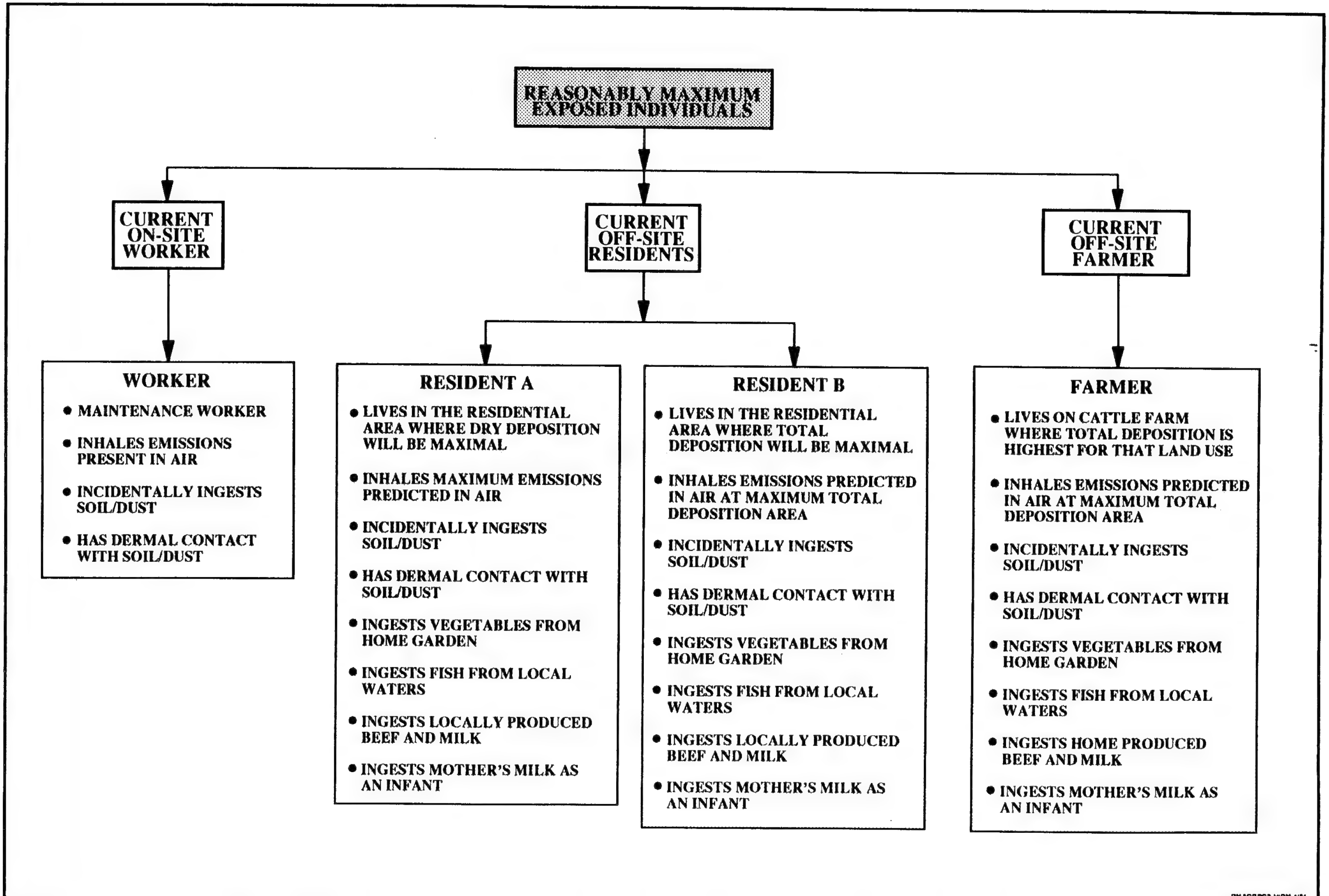

FIGURE ES-1 FOUR EXPOSURE SCENARIOS ADDRESSED IN THE RISK ASSESSMENT FOR THE SQI, ROCKY MOUNTAIN ARSENAL, COLORADO

- Resident A --Located at maximum off-site residential area of dry deposition and air concentration.

- Resident B -- Located at maximum off-site residential area of total deposition.

- Farmer -- Located at maximum off-site agricultural area of total deposition.

- Worker -- Maintenance worker on-site exposed to area-weighted total deposition and air concentration.

• Toxicity Assessment -- Exposure route-specific carcinogenic slope factors and noncarcinogenic reference doses were determined for each chemical evaluated.

• Risk Characterization -- Total lifetime excess carcinogenic risk and noncarcinogenic hazard indices were calculated for each scenario, by chemical and exposure pathway.

• Uncertainty and Sensitivity Analyses -- Uncertainties and assumptions in the risk assessment were evaluated. A quantitative sensitivity analysis was performed on those parameters having the major influence on the risk results.

Health Risk-Based Numerical Emissions Limits

Health risk-based numerical emission limits are not intended to represent emission rate criteria for demonstrating compliance with action and chemical specific applicable or relevant and appropriate requirements (ARARs). Compliance with ARARs will be demonstrated through implementation of monitoring procedures, trial burns, and stack tests.

The list of chemicals evaluated with their respective emission rates determined under average expected (base case) and reasonable worst case (sensitivity case) conditions of operation are shown in Table ES-1.

Under base case conditions, which are conservative upper bound estimates of continuous operating conditions, both total lifetime excess carcinogenic risks and noncarcinogenic

Table ES-1

Emission Rates for Rocky Mountain Arsenal Basin F Waste Submerged Quench Incinerator

Category/ Pollutant	Base Case (a) (ton/yr)	Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)	Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Dioxins/Furans						
U.S. EPA TEF	4.16E-09	1.19E-09	1.50E-10	6.63E-08	1.90E-08	2.39E-09
Metals						
Aluminum	1.80E-02	5.15E-03	6.49E-04	2.50E-02	7.14E-03	8.99E-04
Antimony	6.34E-04	1.81E-04	2.28E-05	1.08E-01	3.10E-02	3.90E-03
Arsenic	3.59E-03	1.03E-03	1.29E-04	8.67E-03	2.48E-03	3.12E-04
Barium	8.79E-04	2.51E-04	3.16E-05	1.83E+01	5.24E+00	6.60E-01
Beryllium	3.66E-05	1.05E-05	1.32E-06	1.53E-03	4.37E-04	5.50E-05
Boron	2.68E-02	7.65E-03	9.63E-04	3.63E-02	1.04E-02	1.31E-03
Cadmium	1.04E-04	2.98E-05	3.76E-06	2.03E-03	5.79E-04	7.30E-05
Calcium	1.54E-01	4.39E-02	5.53E-03	2.93E-01	8.36E-02	1.05E-02
Chromium	2.47E-04	7.05E-05	8.88E-06	3.32E-04	9.49E-05	1.20E-05
Cobalt	7.89E-04	2.25E-04	2.84E-05	8.13E-04	2.32E-04	2.93E-05
Copper	3.35E+00	9.59E-01	1.21E-01	6.35E+00	1.82E+00	2.29E-01
Iron	4.77E-02	1.36E-02	1.72E-03	8.13E-02	2.32E-02	2.93E-03
Lead	1.12E-03	3.21E-04	4.05E-05	3.33E-02	9.52E-03	1.20E-03
Lithium	1.10E-04	3.14E-05	3.96E-06	2.07E-04	5.92E-05	7.45E-06
Magnesium	1.43E-01	4.08E-02	5.14E-03	2.39E-01	6.81E-02	8.59E-03
Manganese	6.16E-03	1.76E-03	2.22E-04	6.93E-03	1.98E-03	2.50E-04
Mercury	9.93E-04	2.84E-04	3.57E-05	1.08E-01	3.10E-02	3.90E-03
Molybdenum	1.10E-02	3.15E-03	3.97E-04	1.14E-02	3.25E-03	4.09E-04
Nickel	2.86E-02	8.18E-03	1.03E-03	2.97E-02	8.49E-03	1.07E-03
Potassium	1.14E+00	3.25E-01	4.09E-02	2.54E+00	7.24E-01	9.13E-02
Selenium	9.20E+00	2.63E+00	3.31E-01	9.20E+00	2.63E+00	3.31E-01
Silicon	1.58E-01	4.52E-02	5.70E-03	1.89E-01	5.41E-02	6.81E-03
Silver	9.52E-02	2.72E-02	3.43E-03	1.08E+00	3.10E-01	3.90E-02
Sodium	1.17E+02	3.34E+01	4.21E+00	5.56E+02	1.59E+02	2.00E+01
Strontium	3.66E-05	1.05E-05	1.32E-06	5.66E-05	1.62E-05	2.04E-06
Thallium	9.25E-03	2.64E-03	3.33E-04	1.08E-01	3.10E-02	3.90E-03
Tin	8.09E-03	2.31E-03	2.91E-04	8.79E-03	2.51E-03	3.16E-04
Titanium	6.10E-05	1.74E-05	2.20E-06	1.07E-04	3.07E-05	3.87E-06
Vanadium	2.34E-03	6.68E-04	8.42E-05	2.62E-03	7.49E-04	9.44E-05
Yttrium	NA	NA	NA	2.14E-05	6.11E-06	7.70E-07
Zinc	1.63E-02	4.65E-03	5.86E-04	3.34E-02	9.54E-03	1.20E-03
Organics						
1,1-Dichloroethene	3.81E-11	1.09E-11	1.37E-12			
1,2-Dichloroethene	2.65E-11	7.57E-12	9.53E-13			
1,2-Dichloropropane	3.07E-12	8.77E-13	1.11E-13			
1,3-Dimethylbenzene	2.72E-08	7.77E-09	9.79E-10			
Acetone	1.07E-11	3.07E-12	3.87E-13			
Ammonia	3.26E-03	9.32E-04	1.17E-04			
Benzene	1.40E-07	3.99E-08	5.03E-09			
Bromomethane	1.36E-08	3.89E-09	4.90E-10			
Carbon Tetrachloride	4.34E-11	1.24E-11	1.56E-12			
Chlorobenzene	3.37E-08	9.62E-09	1.21E-09			
Chloroform	6.87E-12	1.96E-12	2.47E-13			
Ethylbenzene	4.08E-08	1.17E-08	1.47E-09			
Methanol	1.63E-07	4.65E-08	5.86E-09			
Methylene Chloride	1.36E-08	3.89E-09	4.90E-10			
Tetrachlorethene	5.43E-10	1.55E-10	1.95E-11			
Toluene	6.80E-08	1.94E-08	2.45E-09			
Trichloroethene	8.33E-11	2.38E-11	3.00E-12			
Xylene	2.72E-08	7.77E-09	9.79E-10			
4-Chlorophenylmethylsulfone	2.52E-11	7.21E-12	9.08E-13			
4-Chlorophenylmethylsulfoxide	9.40E-11	2.69E-11	3.38E-12			
4-Nitrophenol	5.76E-11	1.64E-11	2.07E-12			
Aldrin	6.91E-12	1.97E-12	2.49E-13			
Atrazine	1.54E-12	4.39E-13	5.53E-14			

Table ES-1
(continued)

Category/ Pollutant	Base Case (a) (ton/yr)	Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)	Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Organics						
Hydrogen Cyanide	6.46E-08	1.85E-08	2.32E-09			
Dieldrin	1.42E-12	4.06E-13	5.11E-14			
Diisopropyl Methylphosphonate	2.49E-10	7.13E-11	8.98E-12			
Dimethyl Methylphosphonate	5.95E-09	1.70E-09	2.14E-10			
Dimethyldisulfide	6.91E-10	1.97E-10	2.49E-11			
Dimethylphosphate	1.63E-09	4.66E-10	5.87E-11			
Dithiane	2.49E-13	7.13E-14	8.98E-15			
Endrin	1.38E-12	3.95E-13	4.97E-14			
Hexachlorocyclopentadiene	1.28E-11	3.67E-12	4.63E-13			
Isodrin	3.64E-12	1.04E-12	1.31E-13			
Malathion	5.56E-12	1.59E-12	2.00E-13			
Parathion	7.68E-13	2.19E-13	2.76E-14			
Supona	2.30E-12	6.58E-13	8.29E-14			
Urea	9.98E-07	2.85E-07	3.59E-08			
Vapona	6.14E-12	1.75E-12	2.21E-13			
p,p-DDE	1.15E-08	3.29E-09	4.14E-10			
p,p-DDT	2.30E-12	6.58E-13	8.29E-14			
PICs with Specific Precursors						
Vinyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Methyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Styrene	1.36E-07	3.90E-08	4.91E-09			
Phenol	7.37E-07	2.11E-07	2.65E-08			
Benzaldehyde	1.42E-07	4.05E-08	5.10E-09			
Benzoic Acid	6.86E-08	1.96E-08	2.47E-09			
Acetonitrile	6.52E-10	1.86E-10	2.35E-11			
Acrylonitrile	6.52E-11	1.86E-11	2.35E-12			
Cyanogen	6.52E-12	1.86E-12	2.35E-13			
Hexachlorobenzene	4.64E-10	1.32E-10	1.67E-11			
Pentachlorobenzene	2.07E-10	5.93E-11	7.47E-12			
Tetrachlorobenzene	8.75E-11	2.50E-11	3.15E-12			
Trichlorobenzene	4.62E-11	1.32E-11	1.66E-12			
Dichlorobenzene	2.45E-11	6.99E-12	8.81E-13			
Biphenyl	6.82E-08	1.95E-08	2.45E-09			
4-Chlorobiphenyl	7.88E-08	2.25E-08	2.84E-09			
4,4-Chlorobiphenyl	1.03E-09	2.95E-10	3.72E-11			
Benzonitrile	6.52E-11	1.86E-11	2.35E-12			
Pyridine	6.52E-12	1.86E-12	2.35E-13			
Carbazole	1.30E-11	3.73E-12	4.70E-13			
Quinoline	3.26E-11	9.32E-12	1.17E-12			
PICs without Specific Precursors						
Benzofuran	2.72E-07	7.77E-08	9.79E-09			
Dibenzofuran	1.36E-08	3.88E-09	4.89E-10			
Acenaphthalene	6.80E-08	1.94E-08	2.45E-09			
Acenaphthene	6.80E-08	1.94E-08	2.45E-09			
Fluoranthene	4.08E-08	1.17E-08	1.47E-09			
Phenanthrene	2.72E-08	7.77E-09	9.79E-10			
Pyrene	1.36E-08	3.88E-09	4.89E-10			
Fluorene	1.36E-08	3.88E-09	4.89E-10			
Benzo(a)pyrene	1.36E-08	3.88E-09	4.89E-10			
Dibenzo(a)anthracene	1.36E-08	3.88E-09	4.89E-10			
Chrysene	1.36E-08	3.88E-09	4.89E-10			

Table ES-1
(continued)

Category/ Pollutant	Base Case (a) (ton/yr)		Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)		Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Acid Gases & Other Compounds								
Particulate Matter	14.00	*(c)*	4.00	0.50	14.00		4.00	0.50
Carbon Monoxide	4.71		1.35	0.17	7.29	*(e)*	2.08	0.26
Hydrogen Chloride	4.73	*(d)*	1.35	0.17	14.00	*(f)*	4.00	0.50
Hydrogen Fluoride	0.17		0.049	0.006	0.32		0.092	0.012
Nitric Acid	3.85		1.10	0.14	3.85		1.10	0.14
Nitrogen Dioxide	32.13		9.18	1.16	143.22	*(f)*	40.92	5.16
Phosphate	3.44		0.98	0.12	15.04		4.30	0.54
Sulfuric Acid	10.40		2.97	0.37	17.34		4.96	0.62
Sulfur Dioxide	24.43	*(d)*	6.98	0.88	101.50	*(f)*	29.00	3.65

(a) These estimates are based upon the acceptable results during the test burn for dioxins/furans and the maximum of the acceptable test results or the maximum of the averages waste stream data for inorganics (including metals, acid gases and other compounds). The volatile and semi-volatile organic emissions are based upon Dellinger's analysis of the maximum of the averages wastestream data.

(b) For metals: based upon the maximum value of the test results from the test burn, the maximum of the maximum values from the wastestream data, and the EPA Guidance Tier II limits for complex terrain.
For dioxins/furans: based upon the 95% confidence interval from WESTON's hazardous waste incinerator emissions database.
For acid gases & other compounds: based upon the maximum value of the test results from the test burn and the maximum of the maximum values from the wastestream data.

(c) Based upon Colorado's emission limitation of 0.08 gr/dscf @ 12% CO_2.

(d) Based upon the February 1989 test burn, which tested for the specific compound.

(e) Based upon Federal emission limitation of 100 ppm.

(f) Based upon vendor performance guarentees.

hazard indices satisfied the criteria specified in the Final Decision Document (Woodward-Clyde, 1990). That is, for any scenario, total lifetime excess carcinogenic risk was less than 1E-06 (1 in 1 million) and hazard index scores were less than 1. The results are briefly summarized in Table ES-2.

In conclusion, the Resident-A scenario represents the nearest most exposed population because it demonstrates the highest carcinogenic and noncarcinogenic health risk; nevertheless, these risk results satisfy the acceptance criteria for cancer risk and noncarcinogenic health effects. Therefore, in accordance with the Final Decision Document (Woodward-Clyde, 1990), the operation of the SQI under base case emissions conditions would meet the requirements of EPA guidance and CERCLA remedial actions to be protective of public health.

Sensitivity case emissions conditions represent reasonable estimates of worst case continuous operating conditions. Under sensitivity case emissions conditions, the calculated total lifetime excess carcinogenic risk satisfied the criteria of 1E-06 in all four scenarios; however, in several cases, hazard indices exceeded 1 by a small margin (see Table ES-3).

The excursions above unity were primarily related to the hazard quotient values in the inhalation pathway for two metals - barium and silver. Barium contributed 49 percent and silver 29 percent to the total hazard index in each specific scenario.

In accordance with guidance established by EPA (Risk Assessment Guidance for Superfund), it was concluded that these exceedances of unity were not of concern for the following reasons:

- EPA Tier II guidance values for hazardous waste emissions were used to provide a highly conservative estimate of sensitivity case emissions for several metals, including barium and silver. These values, which were not required for inclusion in this risk assessment, were four orders of magnitude greater than the maximum values obtained from test burn data. Noncarcinogenic risk (i.e., hazard index) is assumed to be linearly proportional to emission rate,

Table ES-2

Cancer Risk and Hazard Indices Under Base Case Emissions Conditions

Total Lifetime[a]		
Exposure Scenario	Excess Cancer Risk	Hazard Index
Resident A	1.5 E-08	
Adult		0.3
Child		0.8
Infant		0.5
Resident B	2.5 E-09	
Adult		0.1
Child		0.1
Infant		0.1
Farmer	5.9 E-09	
Adult		0.1
Child		0.3
Infant		0.1
Worker	7.6 E-10	
Adult		0.3

[a]Represents the sum of adult, child, and infant carcinogenic risk for each scenario.

Table ES-3

Cancer Risk and Hazard Indices Under Sensitivity Case Emissions Conditions

Total Lifetime		
Exposure Scenario	Excess Cancer Risk	Hazard Index
Resident A	6.1 E-08	
Adult		1.8
Child		4.0
Infant		2.6
Resident B	1.0 E-08	
Adult		0.3
Child		0.6
Infant		0.4
Farmer	2.5 E-08	
Adult		0.6
Child		1.4
Infant		0.9
Worker	2.2E-09	
Adult		0.2

and therefore, the total hazard index scores would fall well below the level of concern (i.e., 1.0) if the more realistic empirical data were used.

- For conservativeness, and for consistency with other routes of exposure, chronic inhalation reference doses (RfDs) were used to estimate risk, even though the duration of inhalation exposure is of a subchronic nature (i.e., less than seven years). The subchronic RfDs for barium and silver are one order of magnitude higher than their subchronic RfDs; therefore, the revised hazard quotients for barium and silver would be one order of magnitude lower than values presented in this analysis. This would result in a net decrease of the total hazard indices to less than 1.0 in all cases.

CONCLUSIONS

A multipathway human health risk assessment was conducted by WESTON for the Army's proposed submerged quench incinerator for the Basin F Liquid Project at Rocky Mountain Arsenal. Based on the results of this report, it is concluded that the operation of this incinerator will pose no human health risk (carcinogenic or noncarcinogenic) as defined in the Final Decision Document, as described in the current EPA guidance for Superfund Risk Assessments, and in accordance with CERCLA remedial action objectives.

SECTION 1

INTRODUCTION

This document is a comprehensive, multiple exposure pathway, human health risk assessment prepared for the proposed Basin F Liquid Incineration Project at the U.S. Army's Rocky Mountain Arsenal (RMA) facility.

The RMA facility is located just north of Stapleton Airport in Denver, Colorado. RMA has been required to install and operate the incinerator, in conjunction with the U.S. Army Corps of Engineers, to destroy over 10.5 million gallons of liquid hazardous waste stored on-site in three tanks and a double-lined pond in an area known as Basin F. The action is part of the Interim Remedial Action (IRA) selected to treat and dispose of Basin F Liquid. As part of the design and implementation phases of this project, outlined in the Final Decision Document (Woodward-Clyde, 1990a), a human health risk assessment is required.

1.1 OBJECTIVES OF THE RISK ASSESSMENT

The primary objective of the health risk assessment conducted by Roy F. Weston Inc. (WESTON) for RMA was to assist in the establishment of chemical emission limits for the Basin F Liquid Incineration Project. These emission limits are to be protective of human health, as stated in the Final Decision Document (Woodward-Clyde, 1990a). A brief summary of the risk characterization results and a discussion of applicable or relevant and appropriate requirements (ARARs) has been presented in the Implementation Document (WESTON, 1990) submitted to RMA in December, 1990. The present document provides the detailed methods and results of the risk assessment, including the air modeling and emissions characterization.

A risk assessment for the proposed Basin F Liquid Incineration Project was previously performed by Woodward-Clyde Consultants (1990b) to assist in the screening and selection of interim remedial actions (IRAs) as required under CERCLA and the National

Contingency Plan. Additionally, on-site (Ebasco, 1990) and off-site (ESE et al., 1989) human health risk assessments have been performed for RMA with respect to worker and residential exposures, respectively, to existing on-site contamination. To maintain consistency with these studies, WESTON reviewed the data from these previous on-site and off-site evaluations and, where relevant, utilized previously developed exposure assumptions and input parameters, toxicity criteria, and background data.

In accordance with the guidance set forth in the Final Decision Document (Woodward-Clyde, 1990a), the approach for the risk assessment process used to establish emission limits was as follows:

- Base case ("average") and sensitivity case (worst case, upper bound) emission rates of the SQI were determined from evaluation of historical waste stream characterization data, test burn data, and WESTON's hazardous waste incinerator emissions inventory, as described in detail in Section 5. The facility has an assumed operational lifetime of 2 years.

- The emissions data were used in conjunction with the air modeling, exposure assessment and toxicity assessment results to calculate noncarcinogenic hazard indices and carcinogenic risk for each chemical and pathway in each proposed exposure scenario.

- As directed in the Final Decision Document (Woodward-Clyde, 1990a), cumulative excess carcinogenic risk and noncarcinogenic hazard indices were determined for each exposure scenario. If it was determined that excess cancer risk did not exceed 1E-06, and the noncarcinogenic hazard index did not exceed 1 for the nearest reasonable maximum exposure scenario, the emission rates predicted for the contaminants of concern were considered protective of human health, the criteria promulgated in the Final Decision Document (Woodward-Clyde, 1990a). WESTON developed four exposure scenarios that were representative of hypothetical maximum exposed individuals in the vicinity of the facility.

- Should the cumulative cancer risk or noncarcinogenic hazard index exceed the limits described above for the most reasonable maximally-exposed individual, each contaminant and pathway assessed in that scenario would be evaluated to develop a profile of the major contributor(s) to risk. A report summarizing these findings would then be presented to the appropriate agencies, as outlined in the Final Decision Document (Woodward-Clyde, 1990a), to

determine whether a change in the design of the treatment system would be necessary.

The risk assessment presented in this report is a comprehensive evaluation that examines all possible direct and indirect exposure pathways and sensitive subpopulations. In addition to the Final Decision Document (Woodward-Clyde, 1990a), the approach and methodology draws upon the guidance set forth in the recently revised United States Environmental Protection Agency (EPA) Risk Assessment Guidance for Superfund: Human Health Evaluation Manual (EPA, 1989) and the Methodology for Assessing Health Risks Associated With Indirect Exposure to Combustor Emissions (EPA, 1990). These and other pertinent guidance documents are cited and referenced in the appropriate sections of this report.

To be consistent with the most recent EPA guidance (EPA, 1989; 1990), WESTON considered certain pathways of indirect exposure that were not originally considered in the SQI risk assessment as part of the IRA (Woodward-Clyde, 1990b). These additional pathways include: breast milk consumption; ingestion of fish from contaminated surface waters; vegetable root uptake of metals and organics; and beef and dairy cattle exposure with subsequent human consumption of homegrown or commercially-produced beef and cow's milk.

1.2 HEALTH RISK ASSESSMENT OVERVIEW

Risk assessment is a complex and continually evolving process drawing upon a variety of disciplines, including air pollution engineering, process engineering, meteorology, environmental resource management, computer technology, biology, chemistry, and toxicology. Regulatory agency requirements for preparing risk assessments, and the need for defensibility of the results, necessitates the inclusion of large amounts of supportive data, often resulting in voluminous documents that may be difficult to review and understand, particularly by the public. A brief summary of the risk assessment process follows to

provide an overall perspective. Each section thereafter is presented in a form that is designed to be understandable to the public.

Figure 1-1 is a flow chart of the major phases of the multipathway human health risk assessment and further serves to identify the individual sections of the report and how they interrelate. The approach used here generally adheres to the guidance recommended by the EPA for conducting a baseline risk assessment for Superfund sites.

Section 2 is a brief description of the proposed submerged quench incinerator with a discussion of the technical components of the system. Geographic and demographic characteristics of the potentially affected area around the facility are discussed in Section 3. Its purpose is to identify land-use patterns and assist in characterizing potentially exposed populations.

A critical technical task is to characterize the chemicals likely to be emitted from the incinerator system and to determine the projected emission rates from the stack (Section 5). The next steps are the assessment of the fate of the chemicals in the atmosphere and the resultant surface deposition (Section 6), followed by the identification of those pollutants that have a realistic potential for contributing to human exposure through specific direct (e.g., inhalation, soil ingestion) and indirect (e.g., consumption of contaminated vegetables, beef, dairy products, fish) pathways (Section 7).

Once the pollutants and pathways are determined, the potential human exposure to these pollutants from all pathways is estimated (Section 8). It is important to note that the estimated pollutant exposure level of sensitive human populations greatly exceeds that likely to occur in terms of the amount, duration, and frequency of actual pollutant exposure. The intent of this approach is to provide the public the benefit of the doubt (i.e., the maximum-exposed individual, or MEI, is unrealistically overexposed relative to the probable exposure of affected populations).

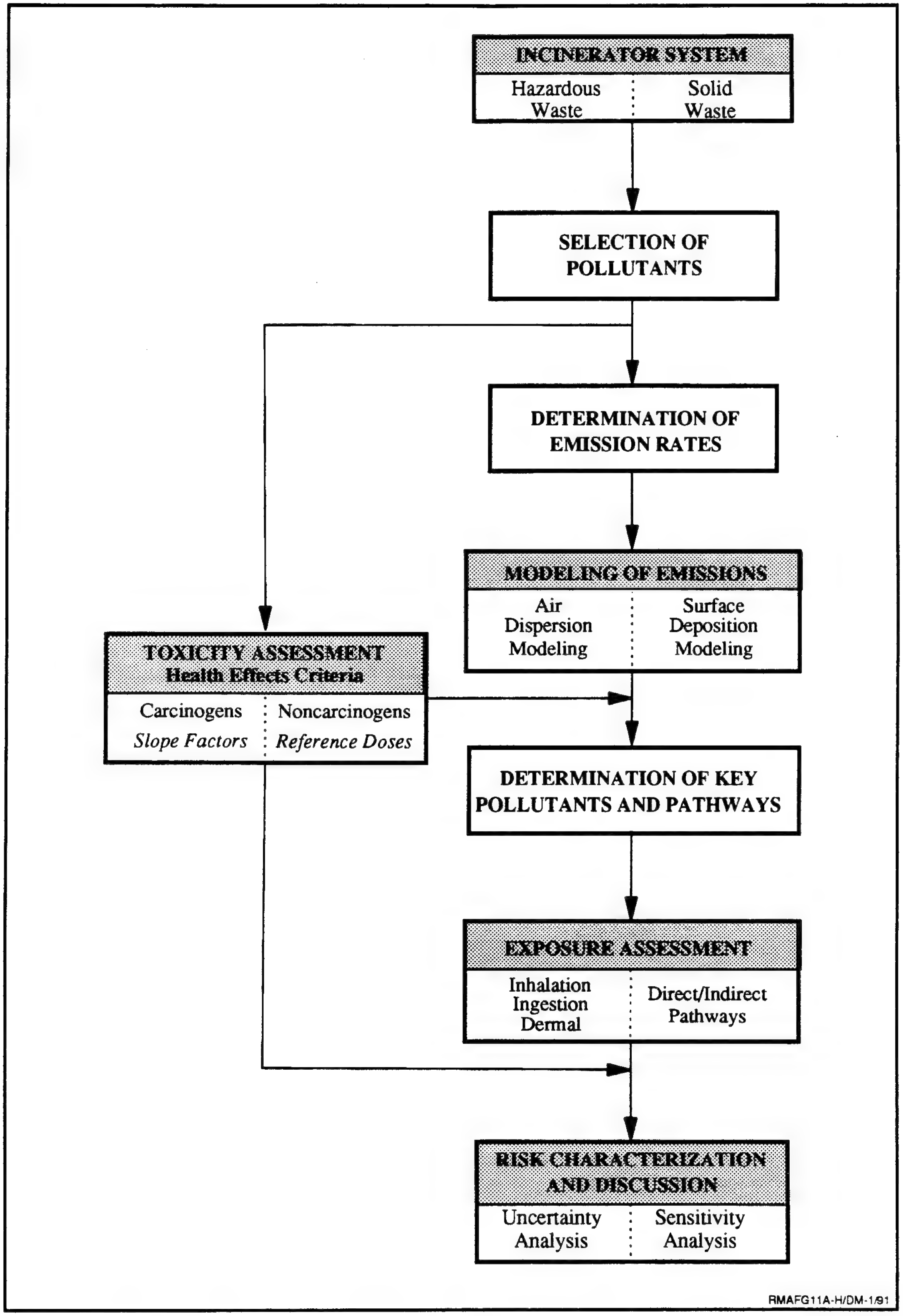

FIGURE 1-1 MULTIPATHWAY RISK ASSESSMENT PROCESS FOR HAZARDOUS OR SOLID WASTE INCINERATORS

The conservatism of both the average case and worst case potential exposure estimates is further amplified by the degree of safety incorporated into the toxicity criteria (i.e., reference doses and cancer potency factors) for the evaluated pollutants. The net result is that both carcinogenic risk and noncarcinogenic hazard indices represent upper-bound estimates of adverse health effects that are unlikely to be achieved or exceeded under actual exposure conditions. The established health effects criteria for these pollutants are discussed in Section 9.

The risk characterization (Section 10) is the process of comparing the estimated potential lifetime daily intakes of the chemicals of concern by the exposed individuals with the allowable exposure level (toxicity criteria). Based on these comparisons, potential carcinogenic risk estimates and the degree of noncarcinogenic adverse health effects can be predicted.

Section 11 of the report discusses the risk results in relationship to the uncertainties and assumptions associated with each step of the risk assessment process. A sensitivity analysis is included in this section, the objective of which is to evaluate quantitatively those factors having the greatest influence on risk. This allows one to obtain a clear perspective of the range of risks in relationship to the important variables inherent in the incinerator operation and the risk assessment process.

SECTION 1

CITED REFERENCES

Ebasco Services Incorporated. 1990. Final Human Health Exposure Assessment for the Rocky Mountain Arsenal, Volume I. Land Use and Exposed Populations. Version 4.1. September, 1990. Contract No. DAAA15-88-0024.

EPA (U.S. Environmental Protection Agency). 1990. Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions, Office of Health and Environmental Assessment, Washington, D.C., EPA/6--/6-90/003.

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A. Interim Final. Office of Solid Waste and Emergency Response. OSWER Directive 9285.701A.

ESE (Environmental Science & Engineering, Inc.), Harding Lawson Associates, and Applied Environmental, Inc. 1989. Technical Support for Rocky Mountain Arsenal. Offpost Operable Unit Endangerment Assessment/Feasibility Study with Applicable and Appropriate Requirements. Volume I. Draft Final Report Version 2.1. March 1989. Contract No. DAAA15-88-D-0021.

Roy F. Weston, Inc. 1990. Draft Implementation Document, Volume 1, Interim Response Action, Basin F Liquid Incineration Project, Preplaced Remedial Action Contract. December, 1990. Contract No. DACW-45-90-D-0015.

Woodward-Clyde Consultants. 1990a. Final Decision Document For The Interim Response Action, Basin F Liquid Treatment, Rocky Mountain Arsenal, Volume I - Text. May 1990. Contract No. DAAA15-88-D-0022/0001. Version 3.2.

Woodward-Clyde Consultants. 1990b. Draft Public Health Risk Assessment Report, Submerged Quench Incinerator, Task IRA-2, Basin F Liquids Treatment Design. January 1990. Contract No. DAAA15-88-D-0022/0001. Version 2.1.

SECTION 2

FACILITY DESCRIPTION

2.1 FACILITY HISTORY

The following facility description is a summary of the information provided in the Final Decision Document (Woodward-Clyde, 1990) for the Basin F Liquid Incineration Project. Rocky Mountain Arsenal (RMA) occupies approximately 17,000 acres (27 square miles) in Adams County, directly northeast of metropolitan Denver, Colorado (Refer to Figure 2-1). RMA was established in 1942 and has been the site of manufacture of chemical incendiary munitions and chemical munitions demilitarization. Agricultural chemicals including pesticides were manufactured at RMA from 1947 to 1982.

In 1956, an evaporation pond called Basin F was constructed in the northern part of RMA. Basin F had a surface area of 92.7 acres and a capacity of approximately 243 million gallons. From August 1957 until its use was discontinued in December 1981, Basin F was the only evaporative disposal facility in service at RMA.

In 1986, the Department of the Army, Shell Oil Company, and the EPA Region VIII, agreed that an accelerated remediation be undertaken pursuant to CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) to contain the liquid and contaminated soils in and under Basin F. In a June 5, 1987 report to the court, the Organizations and the State agreed that fourteen interim actions, including the Basin F Interim Remedial Action (IRA), were necessary to expedite the cleanup of RMA.

In the first part of Basin F remediation, Basin F liquid was transferred to three lined steel storage tanks and to one double-lined covered pond. Transfer of Basin F liquid to tanks and Pond A for interim storage was initiated in May, 1988 and completed in December 1988. Presently approximately 4 million gallons of liquid are stored in the tank farm and 4.5 million gallons are stored in Pond A.

2.2 FACILITY DESCRIPTION

The Army has selected submerged quench incineration (SQI) to thermally treat 10.5 million gallons of stored liquid from Basin F at Rocky Mountain Arsenal as an Interim Remedial Action. The SQI consists of a feed system to inject the Basin F liquid into the incinerator; the high temperature incinerator with a quench chamber to cool the gases and dissolve the molten salts from combustion; a brine concentrator; and associated air pollution control equipment.

2.3 PROCESS DESCRIPTION

The submerged quench incineration process (see Figure 2-2) will use a vertical downfired liquid incinerator. The liquid to be incinerated would be injected at the top of the furnace into a gas flame. Burning the liquid at high temperature (about 1,900°F) is expected to destroy the organic compounds in Basin F liquid. After incineration, all the combustion products will be forced downward and cooled in a liquid quench tank, to aid in washing out particulates and cleaning the exhaust gases. The high temperatures will melt non-combustible components of the Basin F liquid producing molten salts, which will flow down the walls of the incinerator and also be cooled in a quench chamber. The exhaust gases, which will include a mixture of combustion byproducts and other gases, will be passed through air pollution control devices, which include a venturi scrubber and a packed tower. The brine from this process may be disposed of off-site as a liquid.

Operation of the submerged quench incineration process will require the transportation into the Arsenal of 2,600 cubic yards per year of sodium hydroxide, a caustic compound used in the air pollution control process. The submerged quench incineration process will produce salts of about 25 percent of the original volume of the Basin F liquid. These salts, which contain metals, will be disposed of in an off-site hazardous waste landfill.

The facility is expected to operate for a period of 2 years, commencing in late 1991 or early 1992.

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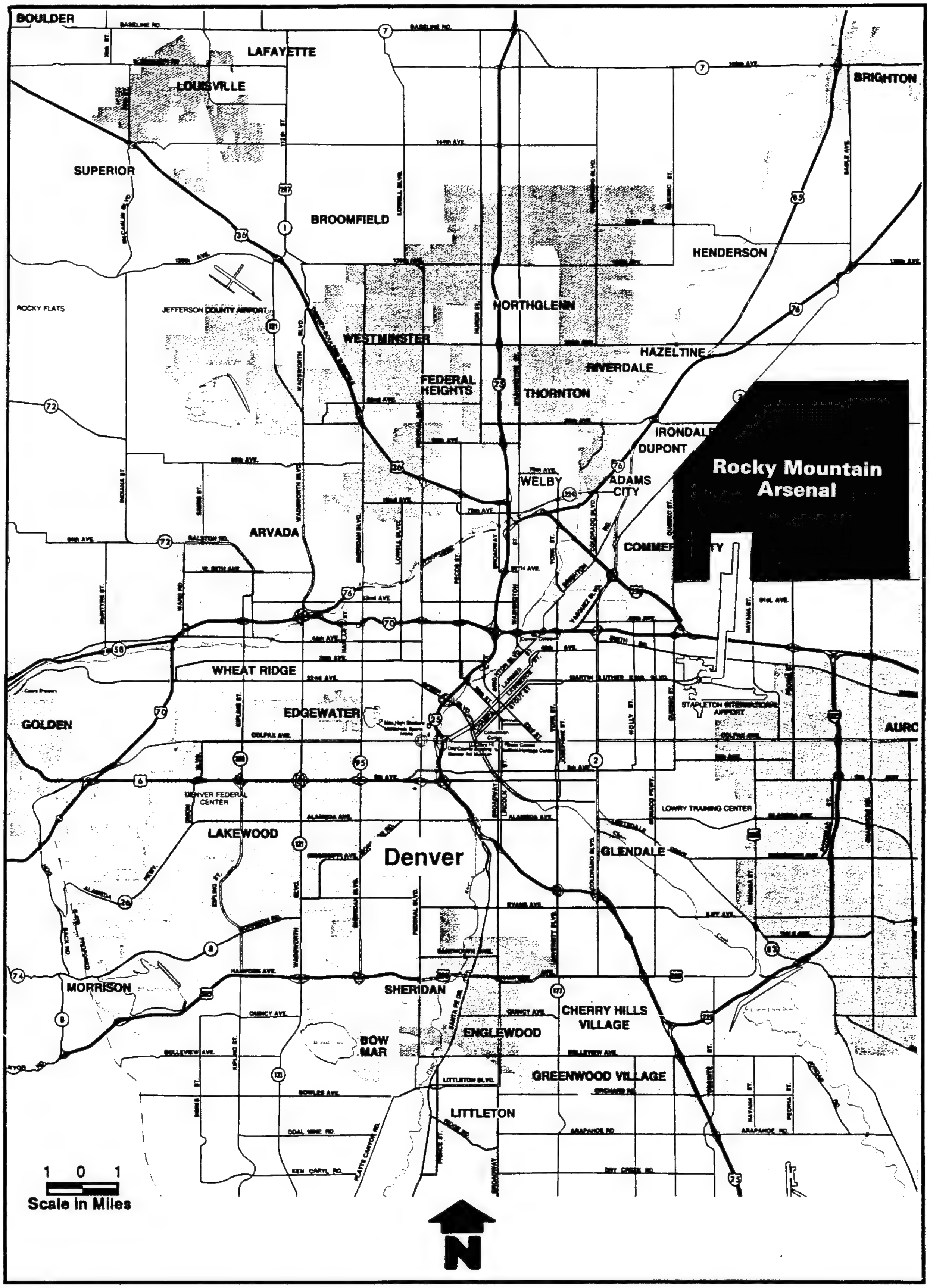


FIGURE 2-1 SITE LOCATION MAP - ROCKY MOUNTAIN ARSENAL

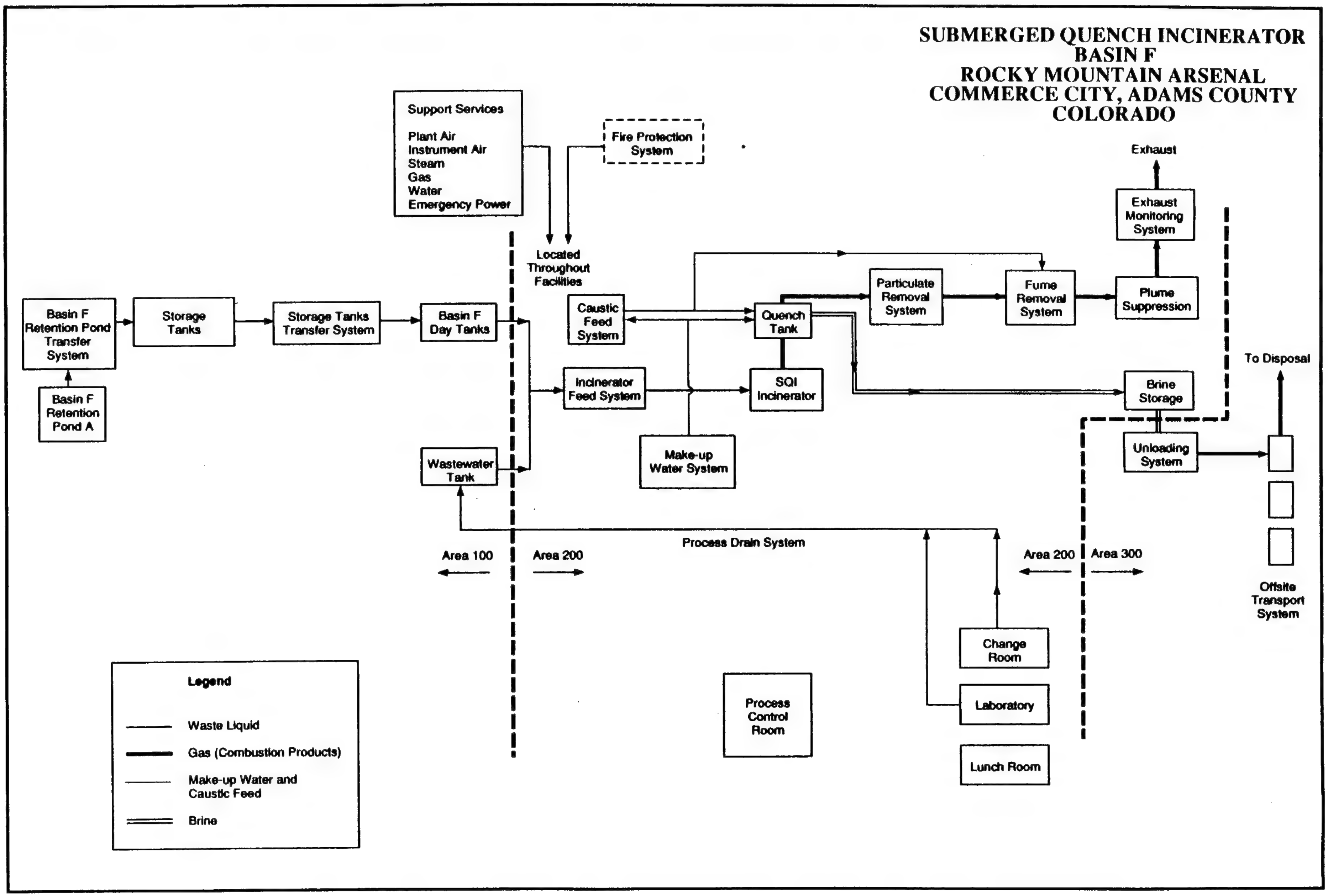


FIGURE 2-2 BLOCK DIAGRAM OF THE SUBMERGED QUENCH INCINERATOR PROCESS

2.4 PHYSICAL EMISSION CHARACTERISTICS

The physical emission characteristics of the submerged quench incinerator have not been finalized at this time. The incinerator will be designed and operated to meet the RCRA incinerator requirements, which are presented in Table 2-1. The trial burn will be required to demonstrate the ability of the incinerator to achieve the performance requirements outlined in the Final Decision Document (Woodward-Clyde, 1990)

2.5 GOOD ENGINEERING PRACTICE ANALYSIS

Section 123 of the Clean Air Act defines Good Engineering Practice (GEP), with respect to stack heights, as "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles." For this analysis, 40 Code of Federal Regulations (CFR) 51.1(ii) defines "nearby" as "...that distance up to five times the lesser of the height or the (projected) width dimension of a structure, but not greater than 0.8 km... ."

According to 40 CFR 51.1(ii), GEP stack height means the greater of the following three factors:

1. 65 meters, measured from the ground-level elevation at the base of the stack.
2. For stacks in existence after January 12, 1979,

   Hg = H + 1.5 L

Where:

Hg	=	GEP stack height
H	=	height of nearby structure(s) measured from the ground-level elevation at the base of the stack
L	=	lesser of height or projected width of nearby structures

Table 2-1

RCRA Incinerator Requirements[a]

Compounds/Emissions	Destruction and Removal Efficiencies
Dioxins and Dibenzofurans	99.9999%
Polychorinated Biphenyls	99.9999%
All other Organic Compounds	99.99%
Particulates Emissions	0.08 grains per dry standard cubic ft. @ 7% O_2
Hydrogen Chloride Emissions	1.8 kg/hour 4.0 lb/hour

[a] 40 CFR 264.343 (Performance Standards)

3. The height demonstrated by fluid model or field study which satisfies the definition of GEP in Section 123 of the Clean Air Act."

This GEP stack height analysis will be based upon the EPA (1985) guideline document. The GEP determination will be made for each building, and then the stack will be associated with the nearby building which would result in the greatest GEP. The stack height for the SQI has not been specified at this time. When the stack height is finalized the GEP analysis described above will be performed to determine if building downwash of the stack gases could occur and if building downwash effects will be incorporated into the modeling analyses.

SECTION 2

CITED REFERENCES

EPA (U.S. Environmental Protection Agency) 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised). Research Triangle Park, NC. (NTIS No. PB 85-225241).

Roy F. Weston, Inc. 1990. Implementation Document (Draft). Interim Response Action, Basin F Liquid Incineration Project, Volume I. Prepared for Program Manager for Rocky Mountain Arsenal, U.S. Army Corps of Engineers, Omaha District. Preplaced Remedial Action Contract. Contract No. DACW-45-90-D-0015.

Woodward-Clyde Consultants. 1990. Final Decision Document For The Interim Response Action, Basin F Liquid Treatment, Rocky Mountain Arsenal Volume I - Text. May 1990. Contract No. DAAA15-88-D-0022/0001. Version 3.2.

SECTION 3

DESCRIPTION OF SURROUNDING AREA

3.1 INTRODUCTION

This section provides an overview of land use and population characteristics of the area around RMA expected to be affected by emissions from the facility. The information compiled is important in identifying:

- Potentially-exposed populations in areas affected by air dispersion or surface deposition of stack emissions
- Population activities that need to be considered in determining both direct and indirect pathways of exposure to stack emissions

Results of the air dispersion and surface deposition modeling isopleths (refer to Section 6) showed the major area to be affected by emissions was within a 10-km radius of the incinerator. Therefore, the evaluation of land usage was particularly focused on the areas predicted by the modeling to have the highest deposition and ambient air concentrations.

3.2 LOCATION AND GEOGRAPHY

The Rocky Mountain Arsenal, located in Adams County, lies approximately 10 miles northeast of downtown Denver. The site occupies 16,914 acres. RMA is bounded by East 96th Avenue on the north, Buckley Road on the east, East 56th Avenue on the south, Quebec Street on the west, and Highway 2 on the northwest. The landscape is generally described as high plains, which is flat and broad (Ebasco, 1990).

3.3 ON-SITE LAND AND WATER USE CHARACTERIZATION

3.3.1 On-Site Land Use

With respect to its former high level of activity, the RMA property can be viewed as an abandoned industrial site. RMA employed as many as 3,000 people when it was a fully operable production facility for chemicals, explosives, agricultural chemicals, and pesticides. Currently there is relatively little activity on the base. The primary activities that do occur involve administration, remediation, and maintenance of the facility.

The current land uses at the RMA site can be classified as industrial, commercial, and recreational. The industrial classification relates to the commercial nature of the existing buildings: an army administration building; fire department; groundwater treatment facilities; rail classification yard; and a post office. The recreational classification is related to the limited occurrence of "catch and throw" fishing (Ebasco, 1990) from several streams on the site. The greatest proportion of acreage at the site is classified as a natural habitat for wildlife, which includes a bald eagle management area on the northwestern section (Ebasco, 1990).

3.3.2 Restrictions Limiting On-Site Land Use

An agreement was made among the EPA, the U.S. Army, Shell Chemical Company, the Agency for Toxic Substances and Disease Registry (ATSDR), and the U.S Department of the Interior. This agreement, called the Federal Facility Agreement (EPA et al., 1989), set forth the following restrictions on RMA (Ebasco, 1990):

- U.S government retains title of the arsenal
- Residential development - **PROHIBITED**
- Wildlife habitat - preserved and managed to protect endangered species
- No major geophysical alterations can be made on-site
- Fish may be caught; fish consumption - **PROHIBITED**

3.3.3 On-Site Water Use

There are several lakes located on the southern sections of the arsenal: Upper Derby, Lower Derby, Mary, and Ladora Lakes. Ladora Lake is the only natural lake. The other lakes were created using water from the Highline Lateral. The Highline Lateral is an aqueduct that is connected to the main Highline Canal, which brings water from the Rocky Mountains into the Denver area.

Surface water drainage at RMA is a complicated process; water on-site is drained by the First and Second Creek. Water from the First and Second Creek is then intercepted by the O'Brian Canal and the Burlington Ditch. Both the O'Brian Canal and the Burlington Ditch then proceed to drain into the South Platte River. Both the O'Brian Canal and the Burlington Ditch are irrigation ditches, which transport water for agricultural purposes (ESE et al., 1989).

3.3.4 Restrictions Limiting On-Site Water Use

Drinking water uses of groundwater and surface water are prohibited by the Federal Facility Agreement (EPA et al., 1989). Presently, there are four groundwater treatment systems located on the northwestern side of the arsenal: Irondale, Northwest Boundary, North Boundary, and Basin A Neck systems. For safety reasons, the North and Northwest Boundary Systems have a bedrock barrier, which separates treated from contaminated water.

After 1957, there is only one water basin (Basin F) located on-site. Basin F was the only evaporative disposal system available at the facility. There are plans, however, to develop more basins and reservoirs for flood control and thereby to prevent contamination of water bodies off-site (Ebasco, 1990).

3.4 OFF-SITE LAND AND WATER USE CHARACTERIZATION

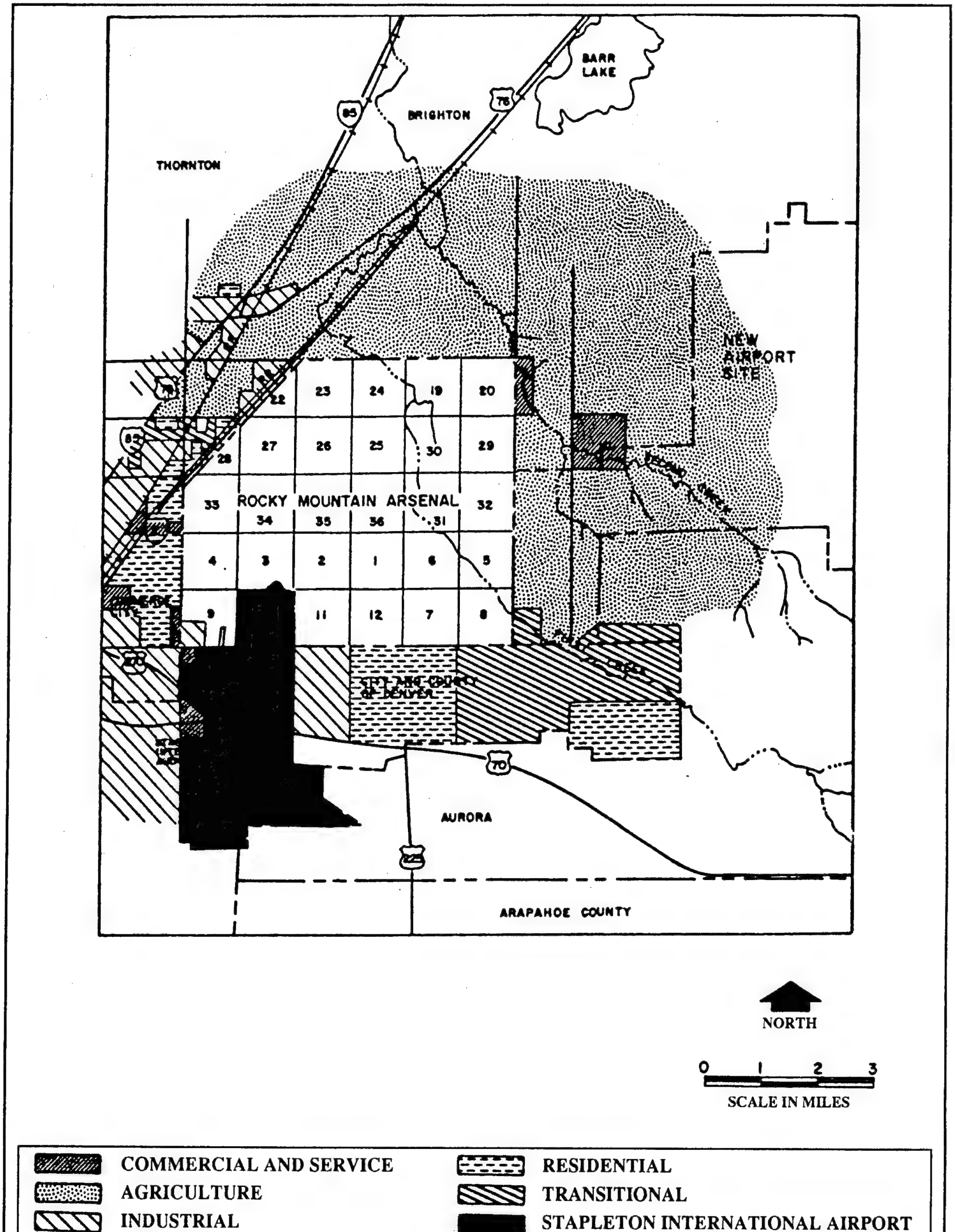
3.4.1 Off-Site Land Use

Land usage around RMA is characterized by a varied pattern of heavy and light industrial, residential, and agricultural designations (Figure 3-1). Agriculture predominates to the north and east, heavy industry to the west and south, and commercial uses primarily to the west. Residential areas are intermixed with commercial zones to the west and south. Commerce City, to the west, is associated with heavy industry, such as petroleum refineries, tank farms, and construction equipment yards. Gravel and sewage treatment facilities to the northwest are located near the South Platte River.

The industry occupying the most acreage near RMA is Stapleton International Airport. This airport is the fifth largest in the United States and has grown rapidly. Recently, plans have been made to relocate the airport to the eastern side of RMA. Originally, the airport was to expand onto RMA land. These plans were rejected because of both the loud airport noise affecting nearby residential areas, and because of the time required to clean up RMA (Ebasco, 1990).

Several residential areas border the RMA property, primarily to the northwest, west, and south (e.g., Irondale, Dupont, Hanson). Adult and childhood activities associated with residences (e.g., outdoor play, school activities, home gardening) have been previously documented (Woodward-Clyde, 1990) and were likewise considered in the development of potential pathways of exposure for this risk assessment.

Since 1950, off-site agricultural land has been used primarily for grain crops, as temporarily idle fields, and to a lesser extent, pasture lands. This area includes approximately 2,500 to 2,700 acres of irrigated farm land. Water for most of this land is supplied primarily by a combination of several irrigation ditches traversing certain areas just off-site (ESE et al., 1989).



SOURCE: EBASCO, 1990 RMAFG31A-H/DM-1/91

FIGURE 3-1 GENERALIZED LAND USE IN THE VICINITY OF ROCKY MOUNTAIN ARSENAL

The primary field crops for this area are winter wheat, hay, barley, corn for grain and silage, sugar beets, and oats. Other crops grown include sorghum, dry beans, and spring wheat. Of the field crops listed, winter and spring wheat, barley, sugar beets, and dry beans are all produced for human consumption (ESE et al., 1989).

Pastureland and livestock are not as important to the rural agronomy as are the grain fields. Pastureland is confined to limited areas, most of which is contiguous with the O'Brian Canal and the Fulton Ditch (ESE et al., 1989).

In view of the large acreage of agricultural land north and east of the site, the possible existence of beef or dairy cattle farms was investigated. Information obtained from the Adams County Agricultural Extension Service suggested there were several feedlots and beef/dairy cattle operations within a 30-km radius of the incinerator. A tour by automobile of the northwestern, northern, and eastern perimeter of RMA in late October, 1990 revealed six locations where cattle were observed grazing near farmhouses or on apparent farmlands. No determination was made as to whether these were dairy or beef cattle.

3.4.2 Off-Site Water Use

Off-site water use (i.e., potable water sources, recreational fisheries) was initially evaluated within a 20-km radius around the proposed incinerator site. Consideration was given to the predicted level of surface deposition on the water body and associated watershed, as well as to the potential for surface water and soil runoff from the RMA site into these water bodies. The objective of this evaluation was to identify any possible uses of local off-site surface waters that should be considered as possible human exposure pathways (i.e., drinking water, fish ingestion).

3.4.2.1 Classification of Rivers, Lakes, and Ponds As Potable Water Supplies

The Department of Natural Resources (DNR) Water Conservation Board, the DNR's State Engineering Board (Water Quality), water treatment plants in Adams County and Denver

County, and the Denver Department of Health (Water Quality) were contacted to identify potable surface water sources. Those designated as potable water supplies were Standley Lake and Marston Lake Reservoir. These lakes and their associated watersheds are well beyond the range of significant aerial deposition predicted from incinerator emissions: Standley Lake is over 16 km west of the incineration site, and Marston Lake Reservoir is located approximately 22 km southwest of the site. It is important to note that surface drainage in this region is toward the northeast; drainage from RMA is directed to the South Platte River, which flows in a north-northeasterly direction (ESE et al., 1989). Therefore, it is unlikely that drainage from RMA would have any effect on potential drinking water sources such as Marston Lake Reservoir or Standley Lake.

3.4.2.2 Classification of Rivers, Lakes, and Ponds as Potential Fisheries

Potential fishing areas within the 10-km radius of the incinerator were evaluated initially from a review of the on-post (Ebasco, 1990) and off-post (ESE et al., 1989) human health exposure assessments. In addition, the DNR Fish and Game Department (Division of Wildlife) and local parks were contacted for fishing information.

Except for the limited "catch and throw" fishing on-site at RMA, no lakes, ponds, or reservoirs were identified as designated fishing areas within a 5-km radius of the incinerator. However, lying in the area between a 5- to 10-km radius of the incinerator site are several lakes and ponds designated as recreational fishing areas.

The only lake located northeast of the arsenal is Barr Lake, a nonpotable water body. Barr Lake is classified as a wildlife refuge on its southern portion, and on its northern half, it is used for recreational purposes, such as fishing. However, based on the air modeling results, this lake does not receive significant aerial deposition (see Section 6). Moreover, even though the lake does lie in the general direction of surface drainage from RMA (i.e., to the northeast), it was concluded that impact via this transport mechanism would not contribute significantly to the total contaminant loading relative to other water bodies closer to RMA (see Engineers Lake below).

Cherry Creek Reservoir, located approximately 20 km southeast of the arsenal, is classified as a flood control reservoir. Although it may support fishing, it is sufficiently out of range of both aerial deposition and drainage originating from the site.

Four smaller water bodies located in Adams County, all approximately 8 km west of RMA, were identified as designated recreational fishing areas; they are:

- Clear Creek Pond
- Engineers Lake
- Rotella Park Pond
- Grandview Ponds 1 to 4

Based on the air dispersion and surface deposition isopleths (Section 6), Engineers Lake was determined to be the water body with the highest potential for impact. Data for surface area and depth of Engineers Lake were provided by the DNR Department of Wildlife and were confirmed by the Adams County Park Service. Some data required for the surface water modeling of contaminant loading, such as flow rates and average suspended solids concentrations, were not available for Engineers Lake, and assumptions were therefore made for these parameters (see Appendix 7A). Appendix 3A contains published data on specific locations and fish populations for Engineers Lake and the other three recreational fishing areas that were evaluated.

Surface water drainage from RMA to the South Platte River is significant, as discussed earlier (Section 3.3.3). Although it is known that the river is fished recreationally, no creel data or designated fishing locations in the vicinity of the drainage area were available. The South Platte River was excluded as a potential human exposure pathway through fish consumption for the following reasons:

- Any contaminants entering the South Platte River as runoff (resulting from on-site deposition from the incinerator) will likely be highly diluted on a continual basis due to the river's low retention time and high flow rate. Therefore, bioaccumulation potential in game fish is anticipated to be relatively low compared with ponds or lakes where retention times are much

longer and the volume of surface water available for contaminant loading is much smaller.

- Deposition into the South Platte River was not significant compared with deposition predicted for the previously discussed recreational fishing areas (i.e., Engineers Lake).

3.5 CONCLUSIONS

On-site and off-site land uses were characterized with respect to human activities relevant to evaluating potential human exposure to incinerator emissions.

It was concluded that the current major activities on-site are maintenance of the grounds and administrative functions. Off-site, residential and agricultural (i.e., livestock, vegetables), land uses, and recreational (i.e., fishing) water uses have been documented. This information was subsequently used in the development of the human exposure pathways and scenarios (Sections 7 and 8).

SECTION 3

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ESE (Environmental Science & Engineering, Inc.), Harding Lawson Associates, and Applied Environmental, Inc. 1989. Technical Support for Rocky Mountain Arsenal. Offpost Operable Unit Endangerment Assessment/Feasibility Study with Applicable and Appropriate Requirements. Volume I. Draft Final Report Version 2.1. March 1989. Contract No. DAAA15-88-D-0021.

Woodward-Clyde Consultants. 1990. Draft Public Health Risk Assessment Report, Submerged Quench Incinerator, Task IRA-2, Basin F Liquids Treatment Design. January 1990. Contract No. DAAA15-88-D-0022/0001, Version 2.1.

SECTION 4

THE PROCESS OF POLLUTANT IDENTIFICATION AND SELECTION

4.1 INTRODUCTION

The purpose of this section is to provide a brief overview of the process by which chemicals emitted from the incinerator were identified and initially selected for evaluation. Figure 4-1 illustrates the basic process of initial pollutant identification and the final pollutant selection process. The primary sources of information used in the identification of the pollutants of concern for this project were historical waste stream data, test burn data, and an analysis of products of incomplete combustion (PICs). In addition to these sources of data, an evaluation of current literature and computer databases for hazardous waste incinerator combustion products was performed to identify possible contaminants that may not be apparent from the site specific data discussed above.

4.2 POLLUTANTS IN THE WASTE PROFILE

Four general groups of pollutants are typically produced in the incineration of hazardous waste. These chemicals are generally categorized as principal organic hazardous constituents (POHCs), products of incomplete combustion (PICs), metals (inorganics), and criteria pollutants (gases, particulates, and acid gases). The complete list of chemicals identified for analysis in this risk assessment is summarized in Table 4-1. The methodology for calculating emission rates is completely discussed in Section 5, and Appendices 5A and 5B. It is important to note that not all of the chemicals in this list are evaluated for every exposure route or pathway. The process by which pollutants are individually selected for the exposure assessment is presented in Section 7.

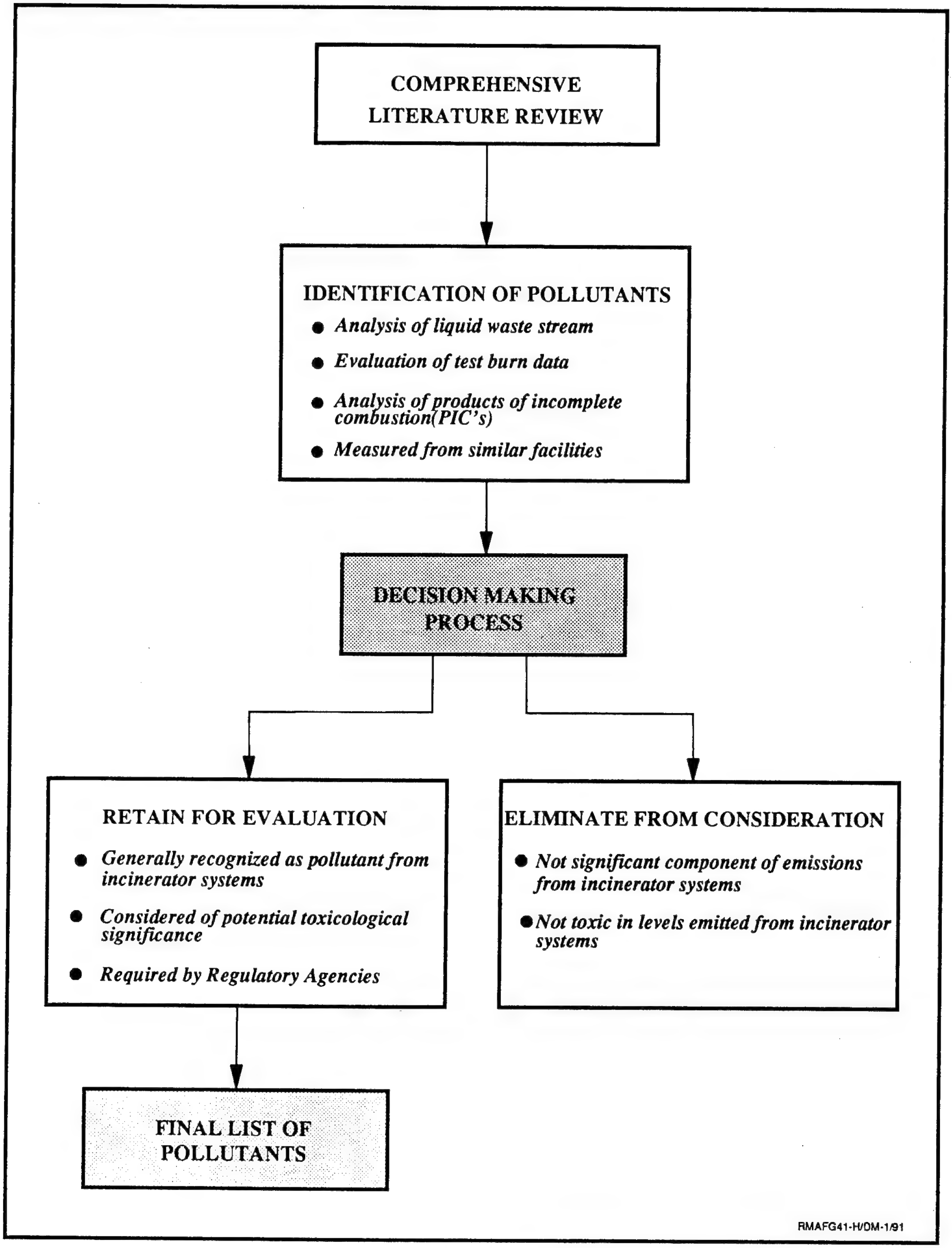


FIGURE 4-1 PROCESS OF POLLUTANT SELECTION

TABLE 4-1
LIST OF POLLUTANTS SELECTED FOR ANALYSIS

Dioxins/Furans

U.S. EPA TEF

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Potassium
Selenium
Silicon
Silver
Sodium
Strontium
Thallium
Tin
Titanium
Vanadium
Yttrium
Zinc

Organics

1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloropropane
1,3-Dimethylbenzene
Acetone
Ammonia
Benzene
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroform
Ethylbenzene
Methanol
Methylene Chloride
Tetrachlorethene
Toluene
Trichloroethene
Xylene
4-Chlorophenylmethylsulfone
4-Chlorophenylmethylsulfoxide
4-Nitrophenol
Aldrin
Atrazine
Hydrogen Cyanide
Dieldrin
Diisopropyl Methylphosphonate
Dimethyl Methylphosphonate
Dimethyldisulfide
Dimethylphosphate
Dithiane
Endrin
Hexachlorocyclopentadiene
Isodrin
Malathion
Parathion
Supona
Urea
Vapona
p,p-DDE
p,p-DDT

PICs with Specific Precursors

Vinyl Chloride
Methyl Chloride
Styrene
Phenol
Benzaldehyde
Benzoic Acid
Acetonitrile
Acrylonitrile
Cyanogen
Hexachlorobenzene
Pentachlorobenzene
Tetrachlorobenzene
Trichlorobenzene
Dichlorobenzene
Biphenyl
4-Chlorobiphenyl
4,4-Chlorobiphenyl
Benzonitrile
Pyridine
Carbazole
Quinoline

PICs without Specific Precursors

Benzofuran
Dibenzofuran
Acenaphthalene
Acenaphthene
Fluoranthene
Phenanthrene
Pyrene
Fluorene
Benzo(a)pyrene
Dibenzo(a)anthracene
Chrysene

Acid Gases & Other Compounds

Particulate Matter
Carbon Monoxide
Hydrogen Chloride
Hydrogen Fluoride
Nitric Acid
Nitrogen Dioxide
Phosphate
Sulfuric Acid
Sulfur Dioxide

4.2.1 Key Organic Pollutants

Organic compounds were identified either as POHCs from an analysis of the waste stream composition or from the analysis of PICs resulting from combustion of the POHCs. Approximately 40 POHCs were identified covering a range of compounds including volatiles, semi-volatiles, and pesticides.

Polychlorinated dibenzo-p-dioxins (dioxins) and polychlorinated dibenzofurans (furans) were determined from an evaluation of test burn data, and are expressed in terms of toxic equivalency factors (TEFs) based on the most recent EPA guidance (EPA, 1989a). The specific congeners and isomers of dioxins and furans were evaluated and are presented in complete detail in Section 5 (Appendix 5A, Table 5A-4). The emissions of dioxins and furans are expressed in terms of their toxicity relationship to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), the most toxic dioxin derivative, and which is assigned a toxic equivalence of unity (1.0). All other congeners have a toxic equivalence of some fraction of 1.0 based on their known or predicted toxicity in various animal tests. This is the EPA accepted approach for the evaluation of exposure to dioxins and furans. Although there are numerous weighting schemes to determine TEFs, WESTON has utilized the 1989 EPA methodology (EPA, 1989a), which is also internationally accepted.

4.2.2 Products of Incomplete Combustion (With or Without Precursors)

Products of incomplete (PICs) are organic compounds present in emissions from an incinerator and which are formed from the thermal breakdown of chemicals present in the waste stream, reformation reactions, or some other process subsequent to incineration (Trenholm and Hathaway, 1984; Oppelt, 1987). Over 30 specific PICs, with or without precursors, were identified (Table 4-1) and their emission rates estimated by Dr. Barry Dellinger[a].

[a] Barry Dellinger, Ph.D. Principal Investigator, Group Leader, Environmental Sciences. University of Dayton Research Institute, Dayton, Ohio. Nationally recognized expert on the evaluation of thermal destruction of organic hazardous waste constituents and the generation of products of incomplete combustion.

4.2.3 Trace Metals

Thirty-one metals were identified for evaluation. Identification of metals and determination of their emission rates was based on the waste stream analysis, test burn data, and EPA Tier II guidance for hazardous waste incineration (EPA, 1989b) as discussed in detail in Section 5.

4.2.4 Criteria Pollutants and Acid Gases

Selected criteria pollutants (particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide) and acid gases (primarily hydrogen chloride and hydrogen fluoride) were identified. Their emission rates were determined from test burn data, vendor guarantees, and WESTON's hazardous waste emissions inventory database.

4.3 Summary

The initial pollutant identification process and its interrelationship with the methodology used to characterize emission rates was discussed.

SECTION 4

CITED REFERENCES

EPA (U.S. Environmental Protection Agency). 1989a. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs) and 1989 Update. Risk Assessment Forum, March 1989. EPA/625/3-89/016.

EPA (U.S. Environmental Protection Agency). 1989b. Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators. Vol. IV. August, 1989.

Oppelt, E.T., 1987 "Incineration of Hazardous Waste:A Critical Review," J. Air Pollution Control Association 37:558.

Trenholm, A. and R. Hathaway, 1984. "Products of Incomplete Combustion from Hazardous Waste Incinerators," in Proceedings, 10th Annual Hazardous Waste Research Symposium, Incineration of Hazardous Waste, U.S. EPA, EPA-600/9-84-022.

SECTION 5

DETERMINATION OF EMISSION RATES

5.1 INTRODUCTION

Once the pollutants are identified, the next step in identifying process emissions is to predict the mass of these pollutants emitted from the stack over time (i.e., the emission rates). Emission factors are used to predict the concentrations and emission rates of the pollutants likely to be emitted from proposed facilities or from facilities for which there are no emissions data. Emission factors account for variations in emissions with respect to facility capacities and stack gas conditions (i.e., moisture content, temperature, and excess air) so that they can be used to estimate likely emissions from a facility that is basically similar in design and operation. Therefore, it is important that the emission factors be developed from emissions data from comparable operating facilities. The assumptions used in developing the emission factors and rates for a specific pollutant emitted from the Rocky Mountain Arsenal Basin F Liquid Waste Submerged Quench Incinerator were based on the waste stream analysis, test burn results, Federal or Colorado regulations, or WESTON's comprehensive database of incinerator emission test results. The key elements of the process used to determine the base case emission factors and rates for a pollutant are presented in a simplified flow diagram (see Figure 5-1). A more detailed discussion of the estimation of both base case and sensitivity case emissions rates is presented in subsection 5.3.

5.2 APPROACH USED TO ESTIMATE EMISSIONS

The current analyses of emissions for four separate groups of pollutants are reported in this section. These categories are: polychlorinated dibenzo-p-dioxins (dioxins or PCDDs) and polychlorinated dibenzofurans (furans or PCDFs); inorganics (trace metals); volatile and semi-volatile organics (including products of incomplete combustion (PICs) and principal organic hazardous constituents (POHCs); and the criteria pollutants and acid gases. To

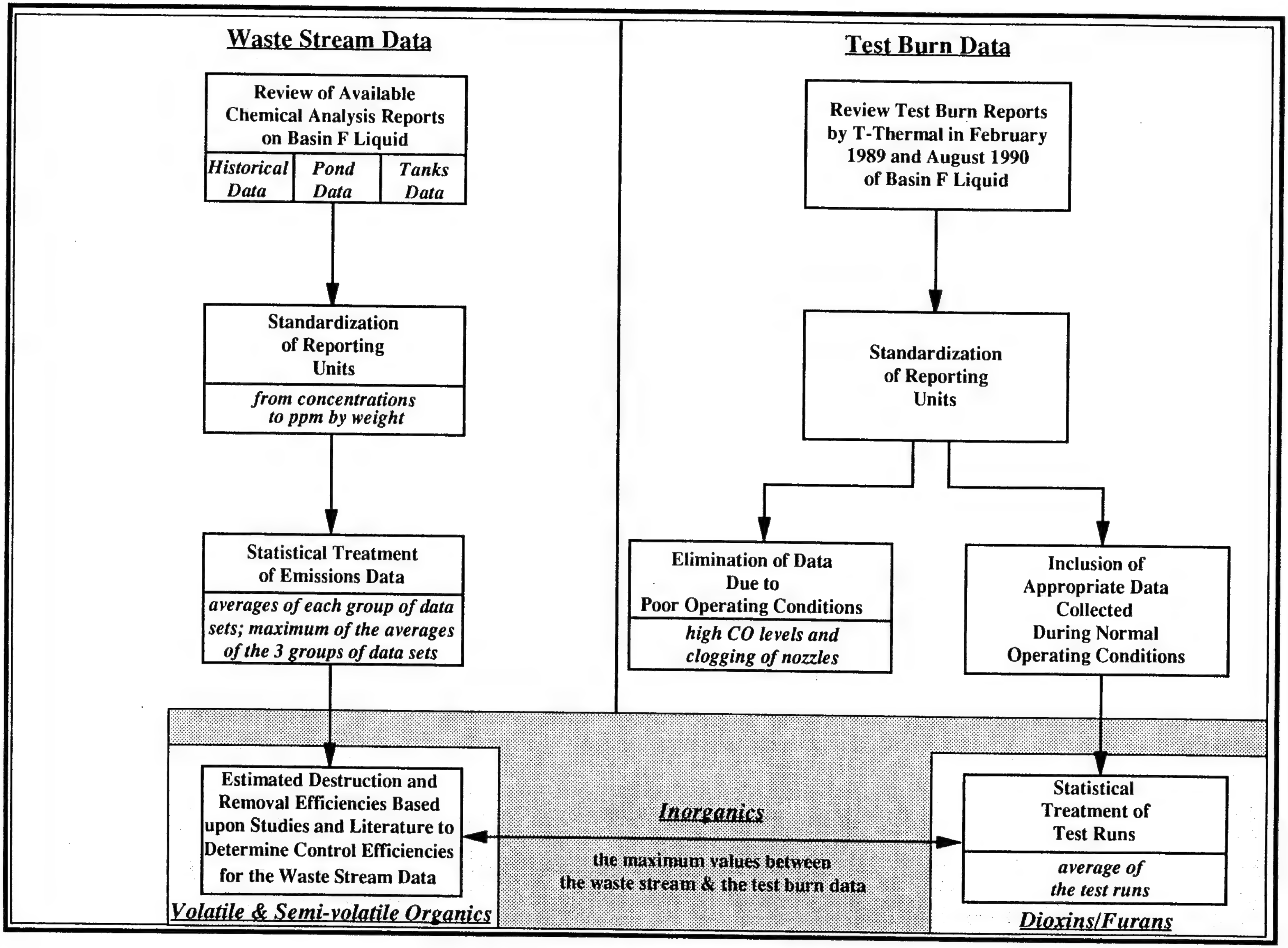


FIGURE 5-1
DETERMINATION OF EMISSION FACTORS FOR THE BASE CASE

provide as conservative an estimate of emissions as possible, the emission factors for each category of pollutants were derived from several methods and were based upon one or several of the following sources:

- The test burn data obtained by T-Thermal in February 1989 and August 1990
- The expected waste feed rate and composition (based upon previous Basin F sampling data) and published EPA control equipment removal efficiencies
- Federal and Colorado emission limitations
- Emission test data obtained from other hazardous waste incineration facilities (from WESTON's comprehensive database)

The first method used to estimate emissions was based on the test burn conducted by T-THERMAL in August 1990. This test burn was comprised of nine test runs performed on a pilot-scale incinerator, which burned Basin F liquid and hydrazine wastewater. Most of the test runs could not be used to develop emission factors because dried waste clogged the atomizing tip of the nozzle during testing. There were no equipment operating difficulties during test runs 4 and 8; therefore, only test runs 4 and 8 were used to estimate the expected emission rates for dioxins and furans. Test run 4 was used to estimate the expected emission rates for metals and other inorganics (criteria pollutants and acid gases). The average of all the test runs was used in determining an upper bound sensitivity scenario for metals and criteria pollutants and acid gases.

The second method used to estimate emissions was based on the expected feed rate of the waste being incinerated. WESTON investigated, collected, and assembled previous analytical data on the Basin F liquids. Sources of information and test data included Rocky Mountain Arsenal, Woodward-Clyde Consultants, T-THERMAL, Waterway Experiment Station, Ebasco, and Shell Oil Company. Testing occurred from 1978 through 1989. WESTON also performed a series of tests on the pond and storage tanks in August and October 1989, and in February and April 1990. All of the test data were reviewed and converted into common units, parts per million by weight. Then the arithmetic mean and

the maximum values were determined for each of the groups of data (historical Basin F, pond, and storage tanks). The maximum of the arithmetic means was determined by taking the highest value of the arithmetic means for the historical Basin F, pond, and storage tank data. Similarly, the maximum of the maximums was determined by taking the highest value of the maximums determined for each group of data.

For certain inorganics, the maximum of the arithmetic mean and maximum of the maximum waste feed values were used to estimate the expected (i.e., base case) and reasonable worst case (i.e., sensitivity case) emissions, respectively. For metals, the volatilization and removal efficiencies for the individual elements were based on the Guidance on Metals and HCL Controls from Hazardous Waste Incineration (EPA, 1989). For acid gases, criteria, and other inorganic pollutants, conversion and removal efficiencies were based upon regulatory requirements, the literature, and data for similar pollutants.

The maximum of the arithmetic means in the waste feed were the basis of expected emission estimates for volatile and semi-volatile organics other than dioxins/furans. Destruction efficiencies and PIC formation rates were estimated by Dr. Barry Dellinger of the University of Dayton Research Institute and were based on the results of his experimental studies. Dr. Dellinger's report is presented as Appendix 5B.

The third method used to determine the emission factors was based on EPA Tier II Guidelines emission levels for metals (EPA, 1989). The Federal government has developed metal emission guidelines (Tier II) for complex and noncomplex terrain, and urban and rural areas. These guidelines were developed as emission levels that would generate acceptable concentrations of carcinogenic metals such that more refined risk analysis would not be required. The sum of the ratios of the expected total emission rates of carcinogenic metals (arsenic, beryllium, cadmium, and chromium) to the Tier II carcinogenic metals emission rates must not exceed 1.0, or a more refined dispersion modeling and risk assessment must be conducted. These emission rates were not applicable to this facility because more refined modeling and risk assessment was conducted; however, the Tier II values were used to develop the sensitivity case emission rates for metals.

The fourth method used to determine emission factors was based upon a comprehensive database of air emissions from waste burning facilities developed by WESTON. The database contains information compiled from 12 hazardous waste incineration facilities. Because there is wide variation among these facilities in terms of incinerator design, processing capacities, stack gas conditions, combustion conditions, and other parameters, emission factors, which are independent of these parameters, are used to standardize emissions data. Emission factors are usually calculated as the mass emissions per unit weight of waste processed (e.g., pounds of pollutant per ton of waste processed), or as the mass emissions per standardized stack gas volume (e.g., nanograms per normal cubic meter of stack gas). Consequently, emission factors can be used to estimate the emissions rates for facilities that may be similar in concept but that may vary in design and operation. The sensitivity case for dioxins and furans was based upon the 95 percent confidence interval (log-normal of the mean) of the emission factors calculated for the facilities in the database.

5.3 PRESENTATION OF EMISSION FACTORS AND EMISSION RATES

Emission factors and emission rates have been developed for the following groups of pollutants:

- Dioxins and furans
- Trace metals
- Volatile and semi-volatile organic compounds (including PICs and POHCs)
- Criteria pollutants and acid gases

The emission factors and the emission rates used in the health risk assessment are presented in Table 5-1. A detailed explanation of the basis for selecting the emission factors and emission rates is presented in Appendix 5A.

Two sets of emission rates are shown in Table 5-1 for each pollutant. The first set, called the base case emission rates, represents the most likely long-term average pollutant emissions. The second set of emission rates, shown in Table 5-1, represent the sensitivity case values. As the sensitivity case analysis is intended to show the effects of higher than

Table 5-1
Emissions Factors and Emissions Rates[a]

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Dioxins/Furans						
U.S. EPA TEF	4.16E-09	1.19E-09	1.50E-10	6.63E-08	1.90E-08	2.39E-09
Metals						
Aluminum	1.80E-02	5.15E-03	6.49E-04	2.50E-02	7.14E-03	8.99E-04
Antimony	6.34E-04	1.81E-04	2.28E-05	1.08E-01	3.10E-02	3.90E-03
Arsenic	3.59E-03	1.03E-03	1.29E-04	8.67E-03	2.48E-03	3.12E-04
Barium	8.79E-04	2.51E-04	3.16E-05	1.83E+01	5.24E+00	6.60E-01
Beryllium	3.66E-05	1.05E-05	1.32E-06	1.53E-03	4.37E-04	5.50E-05
Boron	2.68E-02	7.65E-03	9.63E-04	3.63E-02	1.04E-02	1.31E-03
Cadmium	1.04E-04	2.98E-05	3.76E-06	2.03E-03	5.79E-04	7.30E-05
Calcium	1.54E-01	4.39E-02	5.53E-03	2.93E-01	8.36E-02	1.05E-02
Chromium	2.47E-04	7.05E-05	8.88E-06	3.32E-04	9.49E-05	1.20E-05
Cobalt	7.89E-04	2.25E-04	2.84E-05	8.13E-04	2.32E-04	2.93E-05
Copper	3.35E+00	9.59E-01	1.21E-01	6.35E+00	1.82E+00	2.29E-01
Iron	4.77E-02	1.36E-02	1.72E-03	8.13E-02	2.32E-02	2.93E-03
Lead	1.12E-03	3.21E-04	4.05E-05	3.33E-02	9.52E-03	1.20E-03
Lithium	1.10E-04	3.14E-05	3.96E-06	2.07E-04	5.92E-05	7.45E-06
Magnesium	1.43E-01	4.08E-02	5.14E-03	2.39E-01	6.81E-02	8.59E-03
Manganese	6.16E-03	1.76E-03	2.22E-04	6.93E-03	1.98E-03	2.50E-04
Mercury	9.93E-04	2.84E-04	3.57E-05	1.08E-01	3.10E-02	3.90E-03
Molybdenum	1.10E-02	3.15E-03	3.97E-04	1.14E-02	3.25E-03	4.09E-04
Nickel	2.86E-02	8.18E-03	1.03E-03	2.97E-02	8.49E-03	1.07E-03
Potassium	1.14E+00	3.25E-01	4.09E-02	2.54E+00	7.24E-01	9.13E-02
Selenium	9.20E+00	2.63E+00	3.31E-01	9.20E+00	2.63E+00	3.31E-01
Silicon	1.58E-01	4.52E-02	5.70E-03	1.89E-01	5.41E-02	6.81E-03
Silver	9.52E-02	2.72E-02	3.43E-03	1.08E+00	3.10E-01	3.90E-02
Sodium	1.17E+02	3.34E+01	4.21E+00	5.56E+02	1.59E+02	2.00E+01
Strontium	3.66E-05	1.05E-05	1.32E-06	5.66E-05	1.62E-05	2.04E-06
Thallium	9.25E-03	2.64E-03	3.33E-04	1.08E-01	3.10E-02	3.90E-03
Tin	8.09E-03	2.31E-03	2.91E-04	8.79E-03	2.51E-03	3.16E-04
Titanium	6.10E-05	1.74E-05	2.20E-06	1.07E-04	3.07E-05	3.87E-06
Vanadium	2.34E-03	6.68E-04	8.42E-05	2.62E-03	7.49E-04	9.44E-05
Yttrium	NA	NA	NA	2.14E-05	6.11E-06	7.70E-07
Zinc	1.63E-02	4.65E-03	5.86E-04	3.34E-02	9.54E-03	1.20E-03
Organics						
1,1-Dichloroethene	3.81E-11	1.09E-11	1.37E-12			
1,2-Dichloroethene	2.65E-11	7.57E-12	9.53E-13			
1,2-Dichloropropane	3.07E-12	8.77E-13	1.11E-13			
1,3-Dimethylbenzene	2.72E-08	7.77E-09	9.79E-10			
Acetone	1.07E-11	3.07E-12	3.87E-13			
Ammonia	3.26E-03	9.32E-04	1.17E-04			
Benzene	1.40E-07	3.99E-08	5.03E-09			
Bromomethane	1.36E-08	3.89E-09	4.90E-10			
Carbon Tetrachloride	4.34E-11	1.24E-11	1.56E-12			
Chlorobenzene	3.37E-08	9.62E-09	1.21E-09			
Chloroform	6.87E-12	1.96E-12	2.47E-13			
Ethylbenzene	4.08E-08	1.17E-08	1.47E-09			
Methanol	1.63E-07	4.65E-08	5.86E-09			
Methylene Chloride	1.36E-08	3.89E-09	4.90E-10			
Tetrachlorethene	5.43E-10	1.55E-10	1.95E-11			
Toluene	6.80E-08	1.94E-08	2.45E-09			
Trichloroethene	8.33E-11	2.38E-11	3.00E-12			
Xylene	2.72E-08	7.77E-09	9.79E-10			
4-Chlorophenylmethylsulfone	2.52E-11	7.21E-12	9.08E-13			
4-Chlorophenylmethylsulfoxide	9.40E-11	2.69E-11	3.38E-12			
4-Nitrophenol	5.76E-11	1.64E-11	2.07E-12			
Aldrin	6.91E-12	1.97E-12	2.49E-13			
Atrazine	1.54E-12	4.39E-13	5.53E-14			

Table 5-1
(continued)

Category/ Pollutant	Base Case (a) (ton/yr)	(lb/hr)	(g/sec)	Sensitivity Case (b) (ton/yr)	(lb/hr)	(g/sec)
Organics						
Hydrogen Cyanide	6.46E-08	1.85E-08	2.32E-09			
Dieldrin	1.42E-12	4.06E-13	5.11E-14			
Diisopropyl Methylphosphonate	2.49E-10	7.13E-11	8.98E-12			
Dimethyl Methylphosphonate	5.95E-09	1.70E-09	2.14E-10			
Dimethyldisulfide	6.91E-10	1.97E-10	2.49E-11			
Dimethylphosphate	1.63E-09	4.66E-10	5.87E-11			
Dithiane	2.49E-13	7.13E-14	8.98E-15			
Endrin	1.38E-12	3.95E-13	4.97E-14			
Hexachlorocyclopentadiene	1.29E-11	3.67E-12	4.63E-13			
Isodrin	3.65E-12	1.04E-12	1.31E-13			
Malathion	5.56E-12	1.59E-12	2.00E-13			
Parathion	7.68E-13	2.19E-13	2.76E-14			
Supona	2.30E-12	6.58E-13	8.29E-14			
Urea	9.98E-07	2.85E-07	3.59E-08			
Vapona	6.14E-12	1.75E-12	2.21E-13			
p,p-DDE	1.15E-08	3.29E-09	4.14E-10			
p,p-DDT	2.30E-12	6.58E-13	8.29E-14			
PICs with Specific Precursors						
Vinyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Methyl Chloride	1.36E-07	3.89E-08	4.90E-09			
Styrene	1.36E-07	3.90E-08	4.91E-09			
Phenol	7.37E-07	2.11E-07	2.65E-08			
Benzaldehyde	1.42E-07	4.05E-08	5.10E-09			
Benzoic Acid	6.86E-08	1.96E-08	2.47E-09			
Acetonitrile	6.52E-10	1.86E-10	2.35E-11			
Acrylonitrile	6.52E-11	1.86E-11	2.35E-12			
Cyanogen	6.52E-12	1.86E-12	2.35E-13			
Hexachlorobenzene	4.64E-10	1.32E-10	1.67E-11			
Pentachlorobenzene	2.07E-10	5.93E-11	7.47E-12			
Tetrachlorobenzene	8.75E-11	2.50E-11	3.15E-12			
Trichlorobenzene	4.62E-11	1.32E-11	1.66E-12			
Dichlorobenzene	2.45E-11	6.99E-12	8.81E-13			
Biphenyl	6.82E-08	1.95E-08	2.45E-09			
4-Chlorobiphenyl	7.88E-08	2.25E-08	2.84E-09			
4,4-Chlorobiphenyl	1.03E-09	2.95E-10	3.72E-11			
Benzonitrile	6.52E-11	1.86E-11	2.35E-12			
Pyridine	6.52E-12	1.86E-12	2.35E-13			
Carbazole	1.31E-11	3.73E-12	4.70E-13			
Quinoline	3.26E-11	9.32E-12	1.17E-12			
PICs without Specific Precursors						
Benzofuran	2.72E-07	7.77E-08	9.79E-09			
Dibenzofuran	1.36E-08	3.88E-09	4.89E-10			
Acenaphthalene	6.80E-08	1.94E-08	2.45E-09			
Acenaphthene	6.80E-08	1.94E-08	2.45E-09			
Fluoranthene	4.08E-08	1.17E-08	1.47E-09			
Phenanthrene	2.72E-08	7.77E-09	9.79E-10			
Pyrene	1.36E-08	3.88E-09	4.89E-10			
Fluorene	1.36E-08	3.88E-09	4.89E-10			
Benzo(a)pyrene	1.36E-08	3.88E-09	4.89E-10			
Dibenzo(a)anthracene	1.36E-08	3.88E-09	4.89E-10			
Chrysene	1.36E-08	3.88E-09	4.89E-10			

Table 5-1
(continued)

Category/ Pollutant	Base Case (a) (ton/yr)	Base Case (a) (lb/hr)	Base Case (a) (g/sec)	Sensitivity Case (b) (ton/yr)	Sensitivity Case (b) (lb/hr)	Sensitivity Case (b) (g/sec)
Acid Gases & Other Compounds						
Particulate Matter	14.00 *(c)*	4.00	0.50	14.00	4.00	0.50
Carbon Monoxide	4.71	1.35	0.17	7.29 *(e)*	2.08	0.26
Hydrogen Chloride	4.73 *(d)*	1.35	0.17	14.00 *(f)*	4.00	0.50
Hydrogen Fluoride	0.17	0.049	0.006	0.32	0.092	0.012
Nitric Acid	3.85	1.10	0.14	3.85	1.10	0.14
Nitrogen Dioxide	32.13	9.18	1.16	143.22 *(f)*	40.92	5.16
Phosphate	3.44	0.98	0.12	15.04	4.30	0.54
Sulfuric Acid	10.40	2.97	0.37	17.34	4.96	0.62
Sulfur Dioxide	24.43 *(d)*	6.98	0.88	101.50 *(f)*	29.00	3.65

(a) These estimates are based upon the acceptable results during the test burn for dioxins/furans and the maximum of the acceptable test results or the maximum of the averages waste stream data for inorganics (including metals, acid gases and other compounds). The volatile and semi-volatile organic emissions are based upon Dellinger's analysis of the maximum of the averages wastestream data.

(b) For metals: based upon the maximum value of the test results from the test burn, the maximum of the maximum values from the wastestream data, and the EPA Guidance Tier II limits for complex terrain.
For dioxins/furans: based upon the 95% confidence interval from WESTON's hazardous waste incinerator emissions database.
For acid gases & other compounds: based upon the maximum value of the test results from the test burn and the maximum of the maximum values from the wastestream data.

(c) Based upon Colorado's emission limitation of 0.08 gr/dscf @ 12% CO_2.

(d) Based upon the February 1989 test burn, which tested for the specific compound.

(e) Based upon Federal emission limitation of 100 ppm.

(f) Based upon vendor performance guarentees.

average pollutant emissions on the health risk, the emission factors and emission rates used are on the high end of the expected range of emissions.

The base case toxic equivalence emission factor for dioxin/furan is based on the acceptable runs from the test burn (runs 4 and 8). The sensitivity case toxic equivalence emission factor for dioxin/furan is the upper 95 percent confidence level for WESTON's comprehensive emissions database. The upper 95 percent confidence level was selected for use in the sensitivity case because the 95 percent confidence interval of the mean is a good statistical predictor of two measures: the range within which there is 95 percent confidence that the true mean of the sample facilities would fall, and the range within which 95 percent of the results of new tests on the same or similar facilities would be expected to fall.

For the trace metals, the base case emission factors and emission rates were based on the maximum values from the acceptable runs from the test burn (run 4), or from the controlled maximum of the average values from the waste stream, whichever was greater. Similarly, the metals emission rates developed for the sensitivity case were based on the maximum values among:

- The average of all test runs from the test burn
- The Tier II limitations
- The controlled maximum of the maximum values from the waste stream

The emissions rates for the volatile and semi-volatile organic compounds were based on the maximum of the average values from the waste stream, their destruction efficiencies, and products of incomplete combustion (PICs) as estimated by Dr. Barry Dellinger (Appendix 5B).

The base case emission rates for other inorganic compounds, including acid gases and criteria pollutants were based on the maximum values between the acceptable tests from the trial burn and the controlled maximum of the average values from the waste stream. Since total particulate matter was not determined during the trial burn, Colorado's emission limitation was used. The sensitivity case was based on vendor performance guarantees for

HCl, NO_2, and SO_2. The other pollutants were based on the maximum values between the average of all test runs from the trial burn and the controlled maximum of the maximum values from the waste stream.

SECTION 5

CITED REFERENCES

EPA (U.S. Environmental Protection Agency). 1989. Guidance on Metals and HC1 Controls from Hazardous Waste Incineration. Draft Final Report. August, 1989.

Siebert, P.C., D.R. Alston, J.F. Walsh, K.H. Jones, "Effects on Control Equipment and Operating Parameters on Municipal Solid Waste (MSW) Incinerator Trace Emissions." Paper 88-98.3 presented at the 81st Annual APCA Meeting, Dallas, Texas, 24 June 1988.

Siebert, P.C., D.R. Alston, K.H. Jones, "Toxic Trace Pollutants from Incineration." Presented at the AIChE National Meeting, Philadelphia, Pennsylvania, 23 August 1989.

SECTION 6

AIR QUALITY AND DEPOSITION MODELING ANALYSIS

6.1 INTRODUCTION

Based on the emission factors developed in Section 5, both ambient concentrations and deposition rates can be predicted. Ambient air quality effects were predicted using EPA-approved models. However, there are a number of modifications to these models that have been performed to estimate particle deposition required for the comprehensive all-pathway risk assessment. This section describes the models used, explains the necessary modifications to determine dry and wet deposition, and presents a series of tables summarizing the results of the modeling analysis.

The proposed SQI system is located in an area that is defined as flat or simple terrain, based on EPA criteria. That is, in the impact area of the facility, there is no terrain that is higher than the release height of the stack (base elevation plus stack height). As a result, it was only necessary to conduct one type of modeling analysis to identify the worst-case predicted ground-level impact of the facility on ambient air quality. This included a simple terrain (or noncomplex terrain) analysis.

The simple terrain modeling was conducted using the EPA-approved model known as the Industrial Source Complex Short-Term (ISCST) air dispersion model.

6.2 AIR QUALITY MODELING

The modeling procedure used for the simple terrain analysis followed the recommended techniques described in Guidance on Air Quality Models (Revised), dated July 1986 (EPA, 1986a).

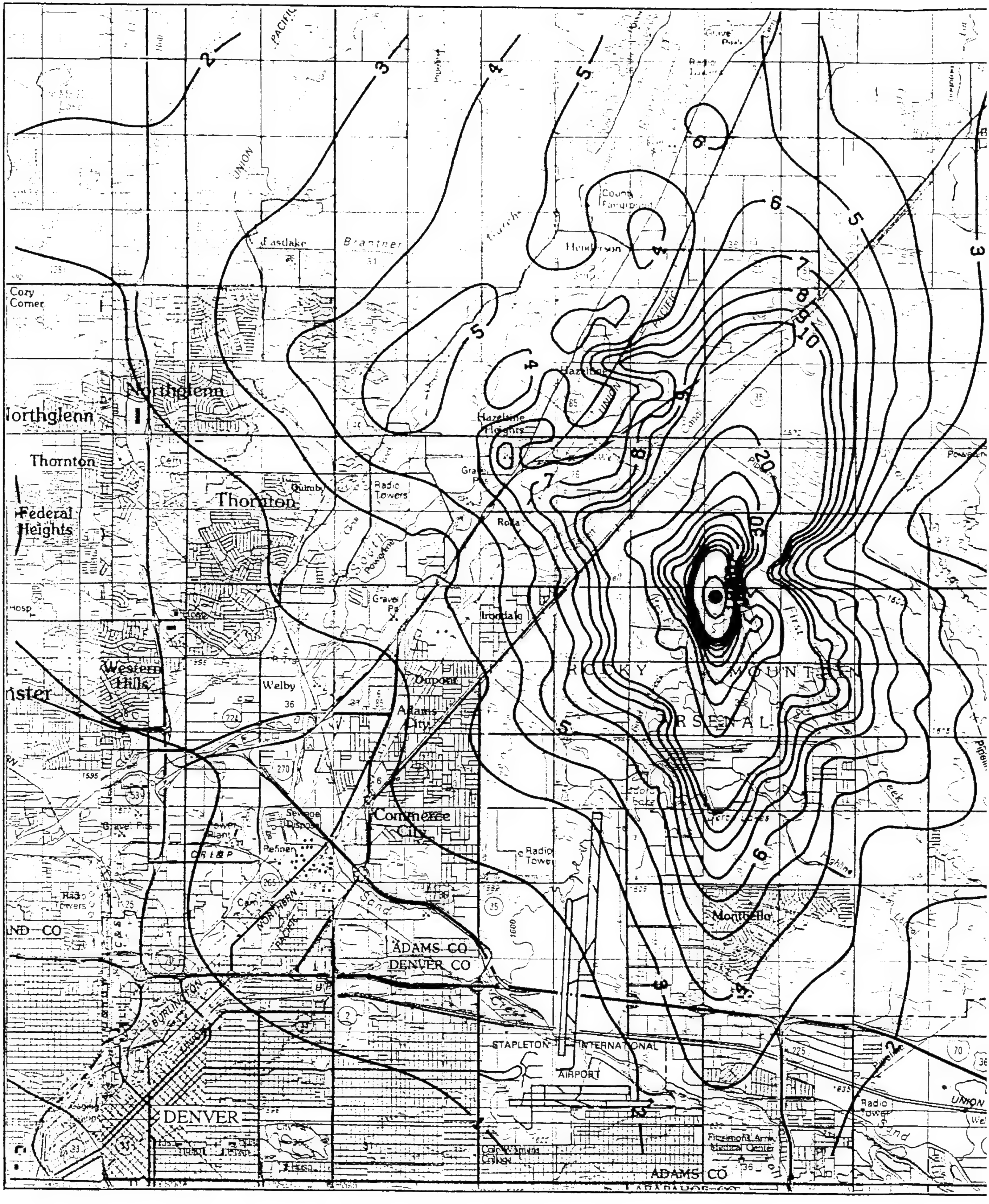
The EPA UNAMAP VI version of the ISCST model was used to calculate ambient pollutant concentrations for all pollutants for the terrain surrounding the facility. The ISCST model was executed in the rural "regulatory" mode, which selects the appropriate constants and features to be consistent with the requirements defined in the Guidance on Air Quality Models (Revised), including:

- Stack tip downwash
- Final plume rise
- Buoyancy-induced dispersion
- Vertical potential temperature gradient
- Treatment for calms
- Wind profile exponents

A dense polar coordinate grid of receptors was established so that the ambient air quality impacts of the facility could be estimated. Figure 6-1 illustrates these estimated ambient air quality impacts through a series of concentration isopleths.

6.3 DEPOSITION MODELING

In the past, health risk assessments for toxic pollutants emitted by hazardous waste incineration facilities have been limited to the inhalation pathway, based on predictions of ambient exposure levels using air quality dispersion models as described earlier. Recently, concerns about potential risks from indirect pathways have led to the necessity of conducting multipathway risk assessments. To conduct such studies, estimates of the rate of deposition over time for toxic pollutants emitted by such facilities are needed. The two major methods for the accumulation of materials in soils, water, and vegetation are wet and dry deposition. The methods used to estimate each of these processes are described in the subsections that follow.



Cozy Corner
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Quimby
Radio Towers
Irondale
Dupont
Adams City
Commerce City
ROCKY MOUNTAIN ARSENAL
Montbello
ADAMS CO
DENVER CO
STAPLETON INTERNATIONAL AIRPORT
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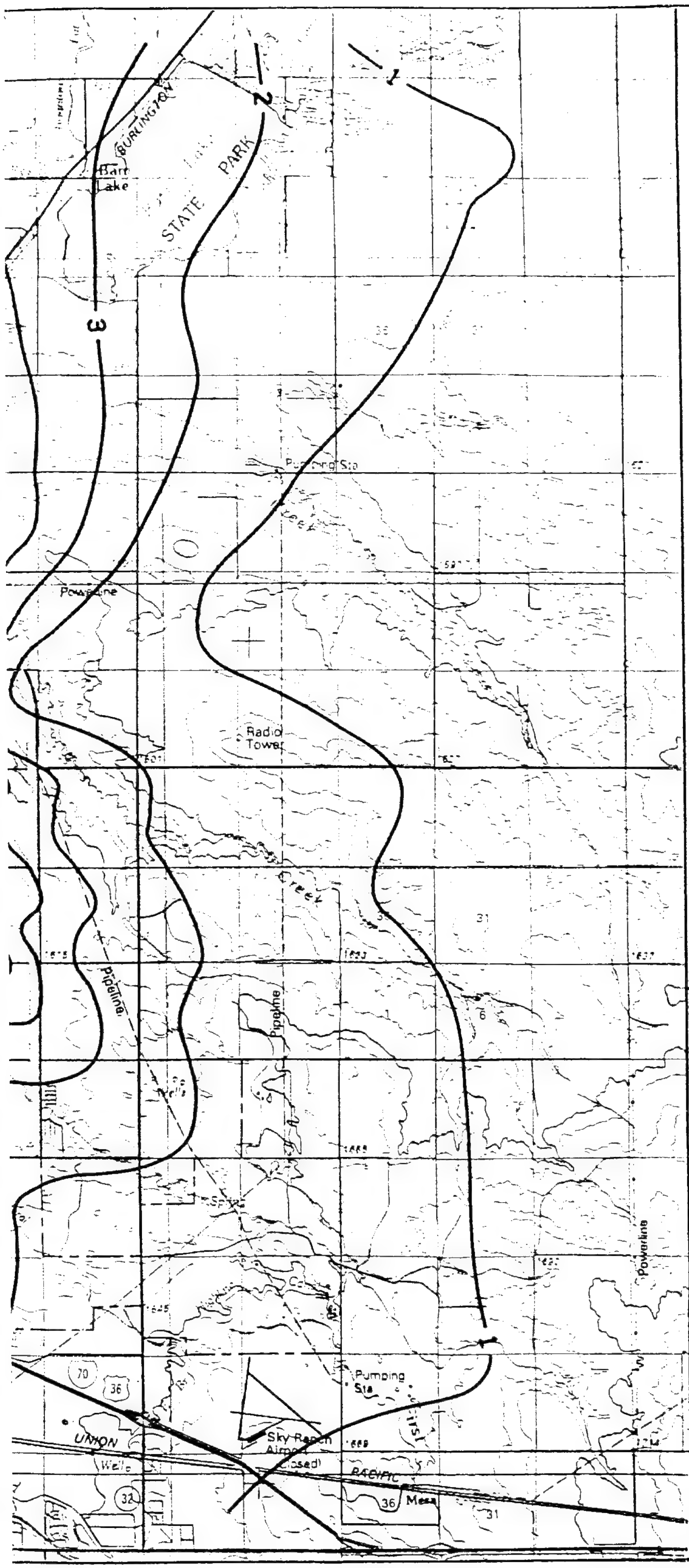
Fitzsimons Army Medical Center
ADAMS CO
UNION PACIFIC
BURLINGTON
NORTHERN PACIFIC
Sand Creek
First Creek
County Fairgrounds
Radio Tower



Legend:

ISOPLETH (µgm/m³)
FIVE YEAR AVERAGE
CONCENTRATION

NORTH

5000 0 5000 15000
SCALE IN FEET

1000 500 0 1000 2000 3000 5000
SCALE IN METERS

SOURCE: BASE MAP ADAPTED FROM USGS 30x60 MINUTE SERIES, DENVER EAST AND DENVER WEST, COLORADO QUADS DATED 1981 AND 1983, RESPECTIVELY

SUBMERGED QUENCH INCINERATOR
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ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, ADAMS COUNTY
COLORADO

FIGURE 6-1
FIVE YEAR AVERAGE CONCENTRATION
ISOPLETH (µgm/m³)

6.3.1 Dry Deposition

Dry deposition is driven by atmospheric processes, the properties of the surfaces upon which materials deposit, and the properties of the particles being deposited. Previous studies of dry deposition have used only gravitational settling velocities to remove particles from the atmosphere. In particular, the EPA's Industrial Source Complex (ISC) model, which contains a gravitational algorithm, has been used in the past to calculate dry deposition. However, this model generally does not account for the properties of the particles deposited, the surface properties that affect dry deposition, or the hourly meteorological effects other than stability.

Work by Sehmel and Hodgsen (1978) has resulted in a parameterization of the dry deposition process, taking more fully into account hourly meteorological conditions (e.g., wind speed, stability, etc.), particle properties (e.g., density, size), and the surface properties (e.g., surface roughness) upon which material is dry deposited.

The basic approach to dry deposition involves calculation of the ambient ground-level concentration and the deposition velocity. The deposition flux is given by:

$$-F = V_d * X_i$$

Where:

$-F$ = Downward flux of material deposited

V_d = Deposition velocity

X_i = Ambient concentration for pollutant i

Therefore, if an estimate of the deposition velocity and the ambient concentration for a pollutant can be made, the dry deposition flux can be calculated. Ransieri and Croes (1987) of the California Air Resources Board (CARB) have developed computer algorithms based on Sehmel and Hodgsen's work that provide hourly values of dry deposition velocity using preprocessed meteorologic data that can be obtained using the EPA preprocessor program.

WESTON has modified the EPA UNAMAP VI version of the ISCST model incorporating the CARB algorithms to calculate dry deposition. This model calculates hourly ambient ground-level pollutant concentrations, as well as hourly deposition velocities, to predict the dry deposition flux at each receptor.

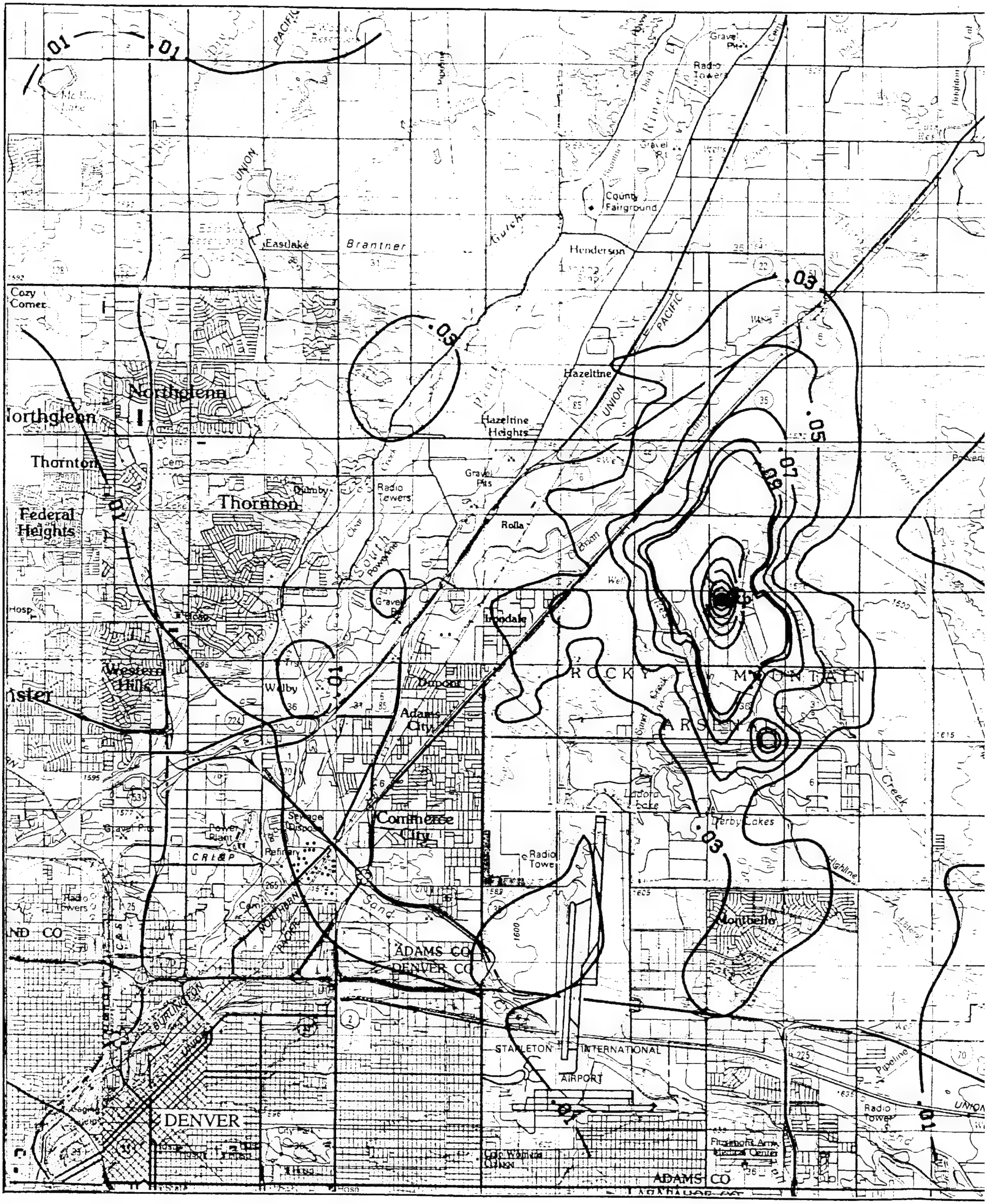
This model allows for building wake effects and terrain adjustments and incorporates a separate surface roughness coefficient (Z_o) for each receptor. Source information required for the model includes:

- Source emission parameters
  - Stack height
  - Stack gas velocity
  - Stack gas temperature
  - Pollutant emission rate
  - Building dimensions (for wake effects option)
- Mass particle size distribution
- Particle density (by size)

Required meteorologic information is provided by the standard UNAMAP meteorologic preprocessor file. In addition, a value for the surface roughness coefficient (Z_o) must be supplied for each receptor. Model output includes the annual average pollutant concentration at each receptor, the total annual dry deposition at each receptor, and the average annual dry deposition velocity at each receptor. Figure 6-2 illustrates the dry deposition in the study area.

6.3.2 Wet Deposition

The wet deposition process involves the removal of particles by precipitation. Currently, no widely accepted wet deposition models are available. Several studies have developed mechanisms for the removal of particles from the atmosphere during a rain storm. These studies assume that particle washout or scavenging is proportional to the mass of the plume



Northglenn
Thornton
Federal Heights
Western Hills
Eastlake
Brantner
Henderson
Hazeltine
Hazeltine Heights
County Fairground
Rolla
Irondale
Welby
Dupont
Adams City
Commerce City
ROCKY MOUNTAIN ARSENAL
Derby Lakes
Montbello
ADAMS CO
DENVER CO
STAPLETON INTERNATIONAL AIRPORT
DENVER
Fitzsimons Army Medical Center
Cozy Corner
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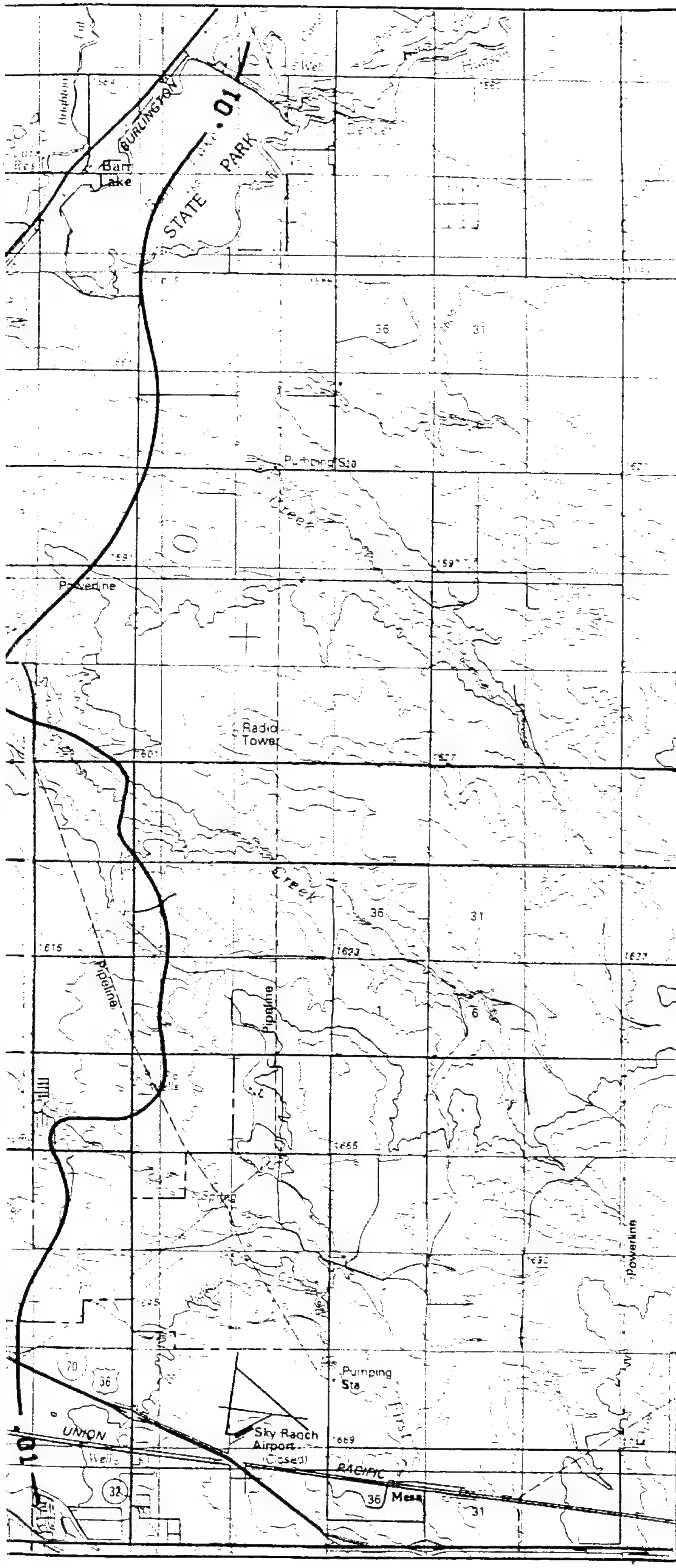

Legend:

.01 — ISOPLETH (gm/m²)
FIVE YEAR AVERAGE
DRY DEPOSITION

NORTH

5000 0 5000 15000

SCALE IN FEET

1000 500 0 1000 2000 3000 5000

SCALE IN METERS

SOURCE: BASE MAP ADAPTED FROM USGS 30x60 MINUTE SERIES, DENVER EAST AND DENVER WEST, COLORADO QUADS DATED 1981 AND 1983, RESPECTIVELY

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FIGURE 6-2
FIVE YEAR AVERAGE DRY DEPOSITION
ISOPLETH (gm/m^2)

exposed to the rain storm, the intensity and duration of the event, and the size distribution of the particles in the plume (Radke et al., 1980; Scire and Lurman, 1983).

The scavenging coefficients that have been developed in these studies are based on a very limited number of original studies and are generally related to removal of sulfate aerosols. For example, the work of Scire and Lurman is for sulfate and nitrate aerosols. Radke et al. included measurements in power plant, pulp and paper boilers, and volcanic plumes that have large concentrations of sulfate aerosols. Since these aerosols are hygroscopic (i.e., they have an affinity for absorbing water in the air), it is likely that scavenging coefficients based on these sources will be higher than for other less water-soluble species, such as the pollutants under consideration in this study. Unfortunately, there are no quantifiable data available upon which to base a more reasonable scavenging coefficient. Therefore, the scavenging coefficients used in this study should be viewed as conservative and should provide an upper bound on the amount of wet deposition likely to occur in an area.

EPA (1986b) has developed an algorithm that uses scavenging coefficients to calculate wet deposition based on the work of Bowman et al. (1987) and Radke et al. (1980). The algorithm includes particle size and rainfall intensity-dependent washout coefficients to calculate wet deposition based on the mass of pollutants in a vertical column of air extending from the bottom to the top of the plume. WESTON has integrated this algorithm into the ISCST model in order to conservatively calculate wet deposition resulting from rain storms.

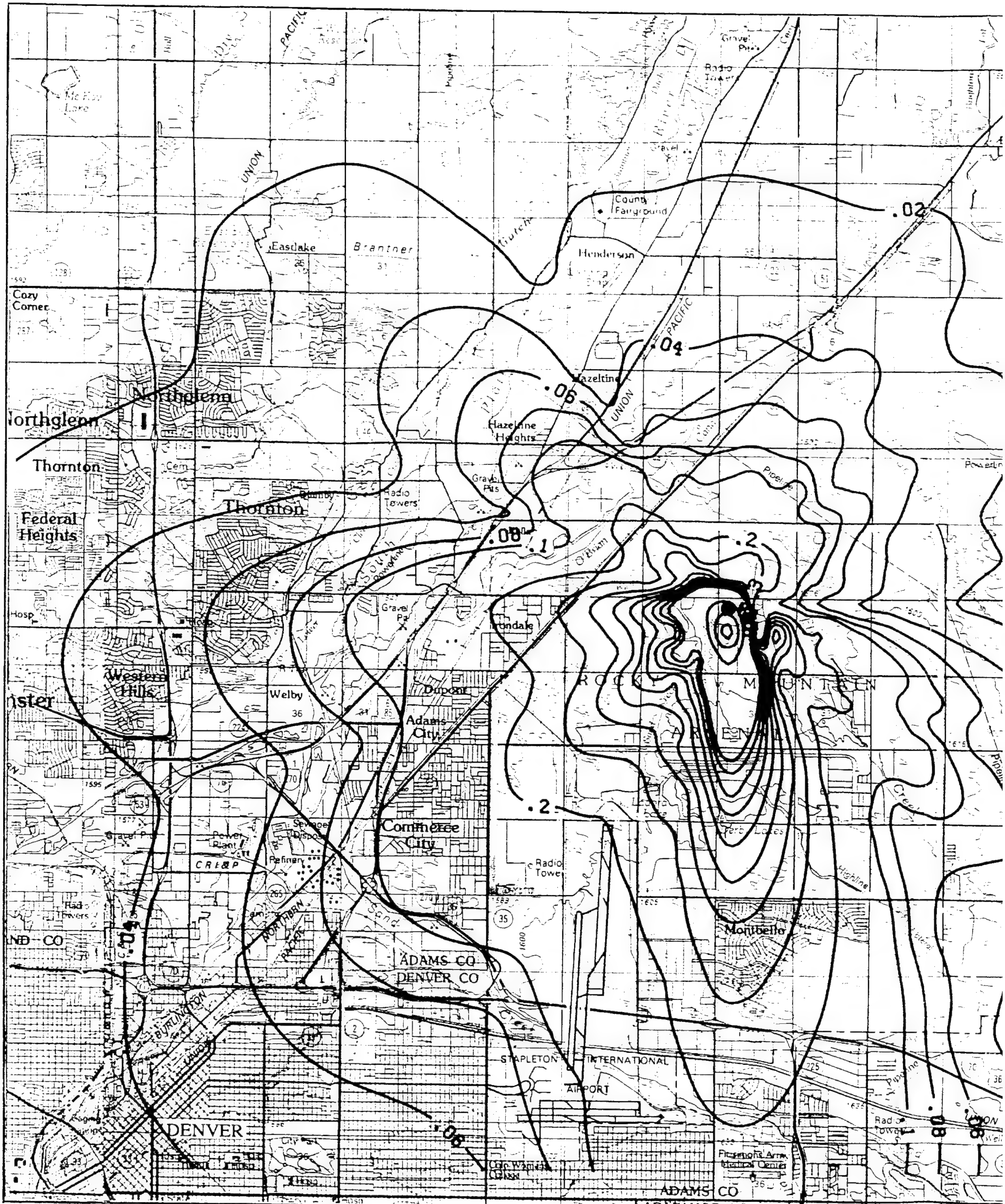
To calculate wet deposition, the same information used for the dry deposition calculation is required (i.e., source-emission characteristics and hour-by-hour meteorology). In addition, rainfall intensity and rainfall type (e.g., thunderstorm, showers, steady precipitation) are also needed. This model has been modified to compute dry deposition only when no wet deposition, i.e., no rainfall, is occurring.

Therefore, the wet and dry algorithms, which are now a part of the WESTON-modified EPA ISC model, enable WESTON to predict the total deposition resulting from emissions from hazardous waste incineration facilities. Figure 6-3 illustrates the predicted total wet deposition in the study area, and Figure 6-4 illustrates the total deposition (wet plus dry). A more detailed description of the overall deposition modeling analysis and relevant parameters are included in Appendix 6A (Air Quality Modeling Protocol).

6.4 AIR QUALITY AND DEPOSITION MODELING RESULTS

As noted in Subsection 6.2, the ISCST model results were used to characterize ambient air quality effects due to facility emissions. Table 6-1 presents the base case emission rates and the annual average ground-level pollutant concentrations of organics, inorganics, and metals as predicted by the model for the exposure scenario. Metals produced the highest risk. Four exposure scenarios were evaluated in terms of human health risk. The exposure assumptions are discussed in detail in Section 8. The highest risk was associated with the Resident-A scenario exposure (refer to Sections 10 and 11 for a full discussion).

The deposition modeling analysis included both dry and wet pollutant deposition. Table 6-2 presents the dry and wet deposition values under the Resident-A scenario exposure.



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Thornton
Federal Heights
Westminster
Western Hills
Welby
Adams City
Commerce City
Dupont
Irondale
Hazeline Heights
Hazeltine
Henderson
County Fairground
Eastlake
Brantner
Cozy Corner
McKay Lake
ROCKY MOUNTAIN ARSENAL
Montbello
ADAMS CO
DENVER CO
STAPLETON INTERNATIONAL AIRPORT
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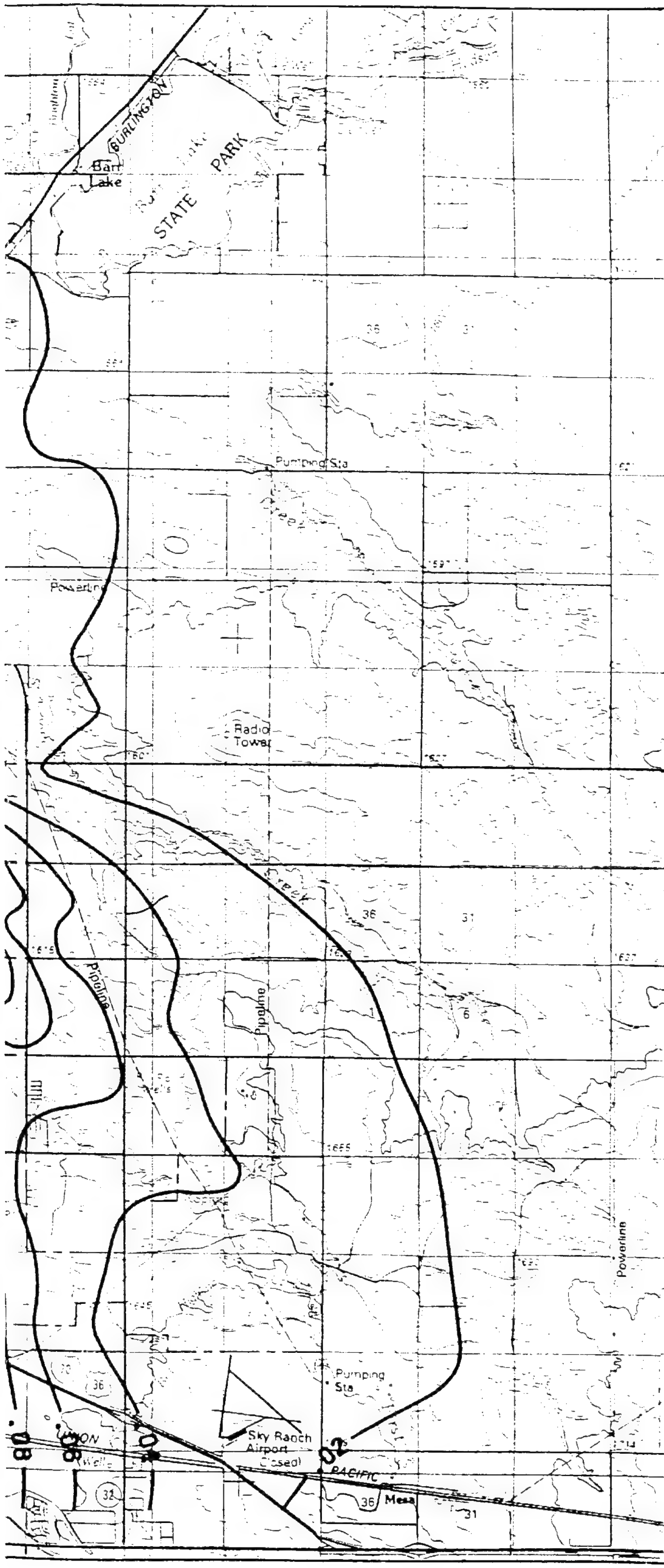

Legend:

.04 — ISOPLETH (gm/m²) FIVE YEAR AVERAGE WET DEPOSITION

NORTH

5000 0 5000 15000

SCALE IN FEET

1000 500 0 1000 2000 3000 5000

SCALE IN METERS

SOURCE: BASE MAP ADAPTED FROM USGS 30x60 MINUTE SERIES, DENVER EAST AND DENVER WEST, COLORADO QUADS DATED 1981 AND 1983, RESPECTIVELY

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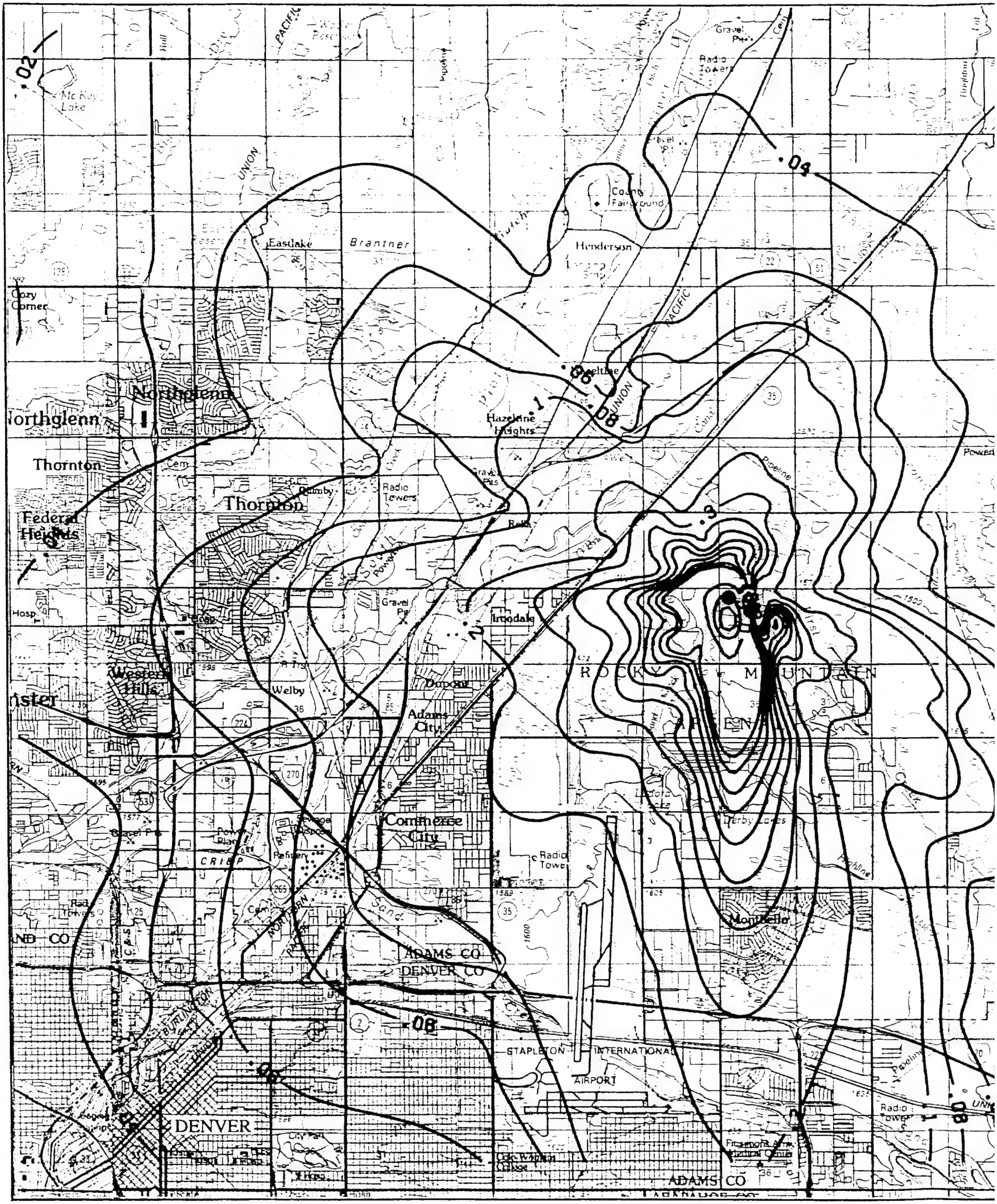
FIGURE 6-3
FIVE YEAR AVERAGE WET DEPOSITION ISOPLETH (gm/m^2)



.02
McKay Lake
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PACIFIC
Gravel Pits
Radio Towers
.04
County Fairground
Eastlake
Brantner
Henderson
Cozy Corner
Northglenn
Thornton
Federal Heights
Hazeltine
Hazeltine Heights
.08
.1
Radio Towers
Quimby
.3
Irondale
Westest Hills
Welby
Dupont
Adams City
Commerce City
ROCKY MOUNTAIN
Derby Lakes
Radio Tower
Montbello
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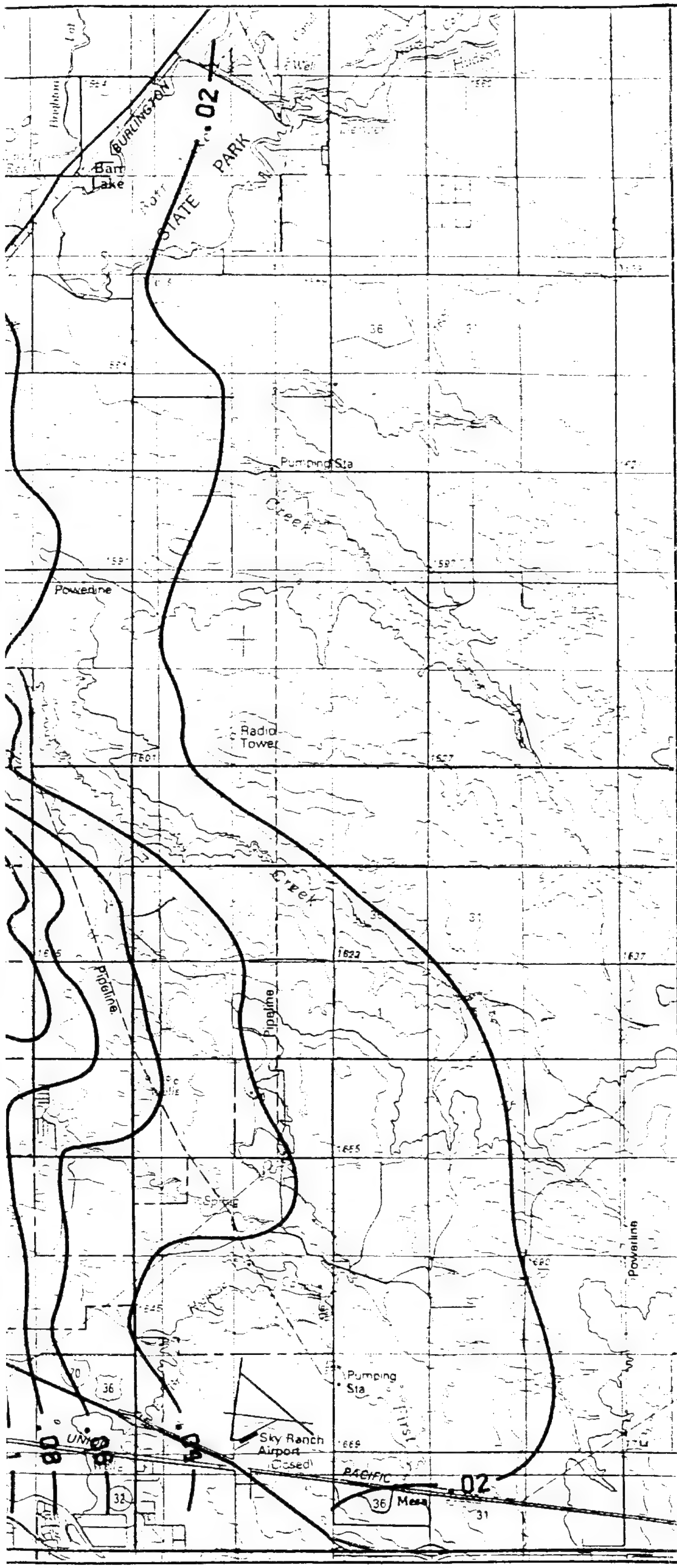
STAPLETON INTERNATIONAL AIRPORT
DENVER
Fitzsimons Army Medical Center
ADAMS CO
Radio Tower
Colo Woman's College



Legend:

—— .1 —— ISOPLETH (gm/m^2)
FIVE YEAR AVERAGE
TOTAL DEPOSITION

NORTH

5000 0 5000 15000

SCALE IN FEET

1000 500 0 1000 2000 3000 5000

SCALE IN METERS

SOURCE: BASE MAP ADAPTED FROM USGS 30x60 MINUTE SERIES, DENVER EAST AND DENVER WEST, COLORADO QUADS DATED 1981 AND 1983, RESPECTIVELY

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COMMERCE CITY, ADAMS COUNTY
COLORADO

FIGURE 6-4
FIVE YEAR AVERAGE TOTAL DEPOSITION
ISOPLETH (gm/m^2)

Table 6-1

Predicted Annual Average Ground-Level Concentration for Resident, Scenario-A

Pollutant	Emission Rate (g/sec)	Annual Average Concentration ($\mu g/m^3$)
ORGANICS		
Acetone	3.87E-13	1.76E-13
Acetonitrile	2.35E-11	1.07E-11
Acrylonitrile	2.35E-12	1.07E-12
Aldrin	2.49E-13	1.14E-13
Atrazine	5.53E-14	2.52E-14
Benzaldehyde	5.10E-09	2.33E-09
Benzene	5.03E-09	2.29E-09
Benzofuran	9.79E-09	4.46E-09
Benzoic Acid	2.47E-09	1.13E-09
Benzonitrile	2.35E-12	1.07E-12
Biphenyl	2.45E-09	1.12E-09
Bromomethane	4.90E-10	2.23E-10
Carbazole	4.70E-13	2.14E-13
Carbon Tetrachloride	1.56E-12	7.11E-13
Chlorobenzene	1.21E-09	5.52E-10
4-Chlorobiphenyl	2.84E-09	1.30E-09
4,4-Chlorobiphenyl	3.72E-11	1.70E-11
Chloroform	2.47E-13	1.13E-13
4-Chlorophenylmethylsulfone	9.08E-13	4.14E-13
4-Chlorophenylmethylsulfoxide	3.38E-12	1.54E-12
p,p-DDE	4.14E-10	1.89E-10
p,p-DDT	8.29E-14	3.78E-14
Dibenzofuran	4.89E-10	2.23E-10
Dichlorobenzenes (total)	8.81E-13	4.02E-13

Table 6-1
(continued)

Pollutant	Emission Rate (g/sec)	Annual Average Concentration ($\mu g/m^3$)
1,4-Dichlorobenzene	5.57E-14	2.54E-14
1,1-Dichloroethene	1.37E-12	6.25E-13
1,2-Dichlorethene	9.53E-13	4.35E-13
1,2-Dichloropropane	1.11E-13	5.06E-14
Dieldrin	5.11E-14	2.33E-14
Diisopropyl Methylphosphonate	8.98E-12	4.09E-12
1,3-Dimethylbenzene	9.79E-10	4.46E-10
Dimethyldisulfide	2.49E-11	1.14E-11
Dimethyl Methylphosphonate	2.14E-10	9.76E-11
Dimethylphosphate	5.87E-11	2.68E-11
Dioxins/Furans (EPA TEFs)	1.50E-10	6.84E-11
Dithiane	8.98E-15	4.09E-15
Endrin	4.97E-14	2.27E-14
Ethylbenzene	1.47E-09	6.70E-10
Hexachlorobenzene	1.67E-11	7.62E-12
Hexachlorocyclopentadiene	4.63E-13	2.11E-13
Isodrin	1.31E-13	5.97E-14
Malathion	2.00E-13	9.12E-14
Methanol	5.68E-09	2.59E-09
Methyl Chloride	4.90E-09	2.23E-09
Methylene Chloride	4.90E-10	2.23E-10
4-Nitrophenol	2.07E-12	9.44E-13
PAHs		
Acenaphthalene	2.45E-09	1.12E-09
Acenaphthene	2.45E-09	1.12E-09
Benzo(a)pyrene	4.89E-10	2.23E-10
Chrysene	4.89E-10	2.23E-10

Table 6-1
(continued)

Pollutant	Emission Rate (g/sec)	Annual Average Concentration ($\mu g/m^3$)
Dibenzo(a,h)anthracene	4.89E-10	2.23E-10
Fluoranthene	1.47E-09	6.70E-10
Fluorene	4.89E-10	2.23E-10
Phenanthrene	9.79E-10	4.46E-10
Pyrene	4.89E-10	2.23E-10
Parathion	2.76E-14	1.26E-14
Pentachlorobenzene	7.47E-12	3.41E-12
Phenol	2.65E-08	1.21E-08
Pyridine	2.35E-13	1.07E-13
Quinoline	1.17E-12	5.34E-13
Styrene	4.91E-09	2.24E-09
Supona	8.29E-14	3.78E-14
Tetrachlorobenzene	3.15E-12	1.44E-12
Tetrachloroethene	1.95E-11	8.89E-12
Toluene	2.45E-09	1.12E-09
Trichlorobenzene	1.66E-12	7.57E-13
Trichloroethene	3.00E-12	1.37E-12
Urea	3.59E-08	1.64E-08
Vapona	2.21E-13	1.01E-13
Vinyl Chloride	4.90E-09	2.23E-09
Xylene	9.79E-10	4.46E-10
INORGANICS		
Aluminum	6.49E-04	2.96E-04
Ammonia	1.17E-04	5.34E-05
Antimony	2.28E-05	1.04E-05
Arsenic	1.29E-04	5.88E-05
Barium	3.16E-05	1.44E-05

Table 6-1
(continued)

Pollutant	Emission Rate (g/sec)	Annual Average Concentration ($\mu g/m^3$)
Beryllium	1.32E-06	6.02E-07
Boron	9.63E-04	4.39E-04
Cadmium	3.76E-06	1.71E-06
Calcium	5.53E-03	2.52E-03
Chromium (III)	8.58E-06	3.91E-06
Chromium (VI)	3.02E-07	1.38E-07
Cobalt	2.84E-05	1.30E-05
Copper	1.21E-01	5.52E-02
Cyanogen	2.35E-13	1.07E-13
Hydrogen Cyanide	2.32E-09	1.06E-09
Iron	1.72E-03	7.84E-04
Lead	4.05E-05	1.85E-05
Lithium	3.96E-06	1.81E-06
Magnesium	5.14E-03	2.34E-03
Manganese	2.22E-04	1.01E-04
Mercury	3.57E-05	1.63E-05
Molybdenum	3.97E-04	1.81E-04
Nickel	1.03E-03	4.70E-04
Phosphate	1.20E-01	5.47E-02
Potassium	4.09E-02	1.87E-02
Selenium	3.31E-01	1.51E-01
Silicon	5.70E-03	2.60E-03
Silver	3.43E-03	1.56E-03
Sodium	4.21E+00	1.92E+00
Strontium	1.32E-06	6.02E-07
Thallium	3.33E-04	1.52E-04
Tin	2.91E-04	1.33E-04

Table 6-1
(continued)

Pollutant	Emission Rate (g/sec)	Annual Average Concentration ($\mu g/m^3$)
Titanium	2.20E-06	1.00E-06
Vanadium	8.42E-05	3.84E-05
Yttrium	7.70E-07	3.51E-07
Zinc	5.86E-04	2.67E-04
CRITERIA POLLUTANTS/ACID GASES		
Carbon Monoxide	1.70E-01	7.75E-02
Hydrogen Chloride	1.70E-01	7.75E-02
Hydrogen Fluorides	6.00E-03	2.74E-03
Nitric Acid	1.40E-01	6.38E-02
Nitrogen Dioxide	1.16E-00	5.29E-01
Particulate Matter	5.00E-01	2.28E-01
Sulfur Dioxide	8.80E-01	4.01E-01
Sulfuric Acid Mist	3.70E-01	1.69E-01

Table 6-2

Total Deposition Rates for Resident, Scenario-A ($g/m^2/yr$)

Pollutant	Dry Deposition	Total Deposition
ORGANICS		
Acetone	NA	NA
Acetonitrile	4.39E-14	8.22E-14
Acrylonitrile	NA	NA
Aldrin	4.66E-16	8.71E-16
Atrazine	1.03E-16	1.94E-16
Benzaldehyde	9.54E-12	1.78E-11
Benzene	NA	NA
Benzofuran	1.83E-11	3.43E-11
Benzoic Acid	4.62E-12	8.64E-12
Benzonitrile	4.39E-15	8.22E-15
Biphenyl	NA	NA
Bromomethane	NA	NA
Carbazole	8.79E-16	1.64E-15
Carbon Tetrachloride	NA	NA
Chlorobenzene	NA	NA
4-Chlorobiphenyl	5.31E-12	9.94E-12
4,4-Chlorobiphenyl	6.96E-14	1.30E-13
Chloroform	NA	NA
4-Chlorophenylmethylsulfone	1.70E-15	3.18E-15
4-Chlorophenylmethylsulfoxide	6.32E-15	1.18E-14
p,p-DDE	7.74E-13	1.45E-12
p,p-DDT	1.55E-16	2.90E-16
Dibenzofuran	9.14E-13	1.71E-12
Dichlorobenzenes (total)	NA	NA
1,4-Dichlorobenzene	NA	NA

Table 6-2
(continued)

Pollutant	Dry Deposition	Total Deposition
1,1-Dichloroethene	NA	NA
1,2-Dichloroethene	NA	NA
1,2-Dichloropropane	NA	NA
Dieldrin	9.56E-17	1.79E-16
Diisopropyl Methylphosphonate	1.68E-14	3.14E-14
1,3-Dimethylbenzene	1.83E-12	3.43E-12
Dimethyldisulfide	NA	NA
Dimethyl Methylphosphonate	4.00E-13	7.49E-13
Dimethylphosphate	1.10E-13	2.05E-13
Dioxins/Furans (EPA TEFs)	2.80E-13	5.25E-13
Dithiane	1.68E-17	3.14E-17
Endrin	9.29E-17	1.74E-16
Ethylbenzene	NA	NA
Hexachlorobenzene	3.12E-14	5.84E-14
Hexachloropcyclopentadiene	8.66E-16	1.62E-15
Isodrin	2.45E-16	4.58E-16
Malathion	3.74E-16	7.00E-16
Methanol	1.06E-11	1.99E-11
Methyl Chloride	NA	NA
Methylene Chloride	NA	NA
4-Nitrophenol	7.24E-15	3.87E-15
PAHs		
Acenaphthalene	8.57E-12	4.58E-12
Acenaphthene	8.57E-12	4.58E-12
Benzo(a)pyrene	1.71E-12	9.14E-13
Chrysene	1.71E-12	9.14E-13
Dibenzo(a,h)anthracene	1.71E-12	9.14E-13
Fluoranthene	5.14E-12	2.75E-12

Table 6-2
(continued)

Pollutant	Dry Deposition	Total Deposition
Fluorene	1.71E-12	9.14E-13
Phenanthrene	3.43E-12	1.83E-12
Pyrene	1.71E-12	9.14E-13
Parathion	9.66E-17	5.16E-17
Pentachlorobenzene	2.61E-14	1.40E-14
Phenol	9.27E-11	4.96E-11
Pyridine	NA	NA
Quinoline	4.09E-15	2.19E-15
Styrene	NA	NA
Supona	2.90E-16	1.55E-16
Tetrachlorobenzene	1.10E-14	5.89E-15
Tetrachloroethene	NA	NA
Toluene	NA	NA
Trichlorobenzene	5.81E-15	3.10E-15
Trichloroethene	NA	NA
Urea	1.26E-10	6.71E-11
Vapona	7.73E-16	4.13E-16
Vinyl Chloride	NA	NA
Xylene	NA	NA
INORGANICS		
Aluminum	NA	NA
Ammonia	NA	NA
Antimony	7.98E-08	4.26E-08
Arsenic	4.51E-07	2.41E-07
Barium	1.11E-07	5.91E-08
Beryllium	4.62E-09	2.47E-09
Boron	NA	NA
Cadmium	NA	NA

Table 6-2
(continued)

Pollutant	Dry Deposition	Total Deposition
Calcium	NA	NA
Chromium (III)	NA	NA
Chromium (VI)	NA	NA
Cobalt	NA	NA
Copper	4.23E-04	2.26E-04
Cyanogen	NA	NA
Hydrogen Cyanide	NA	NA
Iron	NA	NA
Lead	1.42E-07	7.57E-08
Lithium	NA	NA
Magnesium	NA	NA
Manganese	NA	NA
Mercury	1.25E-07	6.68E-08
Molybdenum	NA	NA
Nickel	NA	NA
Phosphate	NA	NA
Potassium	NA	NA
Selenium	1.16E-03	6.19E-04
Silicon	NA	NA
Silver	6.41E-06	1.20E-05
Sodium	NA	NA
Strontium	NA	NA
Thallium	6.23E-07	1.17E-06
Tin	NA	NA
Titanium	NA	NA
Vanadium	NA	NA
Yttrium	NA	NA
Zinc	NA	NA

SECTION 6

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SECTION 7

DETERMINATION OF KEY PATHWAYS AND POLLUTANTS

7.1 INTRODUCTION

The exposure assessment serves as the cornerstone of the risk assessment process, providing an evaluation of the potential human exposure to the chemicals of concern. The source of the chemicals of concern in this risk assessment is the stack of the proposed submerged quench incinerator at the Rocky Mountain Arsenal. Human exposure to these emitted chemicals may occur through several potential environmental pathways (air, water, and soil) and by several routes of exposure (inhalation, ingestion, and dermal contact). The first important step of the exposure assessment is to identify the relevant pathways and routes of exposure that are specific to off-site and on-site receptors.

Gases and particulates emitted from the proposed resource recovery facility are a complex mixture of elements and compounds. Not all of these emissions produce an adverse health effect through all exposure pathways. Therefore, a preliminary evaluation was performed to determine the pollutants of concern in each environmental pathway and to ensure that all pathways and pollutants that may potentially pose a risk to human health were ultimately addressed.

This section discusses in detail the process of pathway and pollutant selection. Based upon a comprehensive analysis of site characteristics, the pathways and pollutants that are clearly of no significance to health risk were eliminated from further consideration. The subsequent evaluation then focuses on those pathways and pollutants most critical to the risk assessment. It is important to note that the criteria used to screen potential pollutants and pathways are extremely conservative such that one can have a high degree of confidence that the inclusion of these eliminated pathways and pollutants in the risk assessment would have had only a negligible effect on the results. Particular emphasis is placed on an evaluation

of pollutants and pathways of specific concern for infants and children, who represent sensitive subgroups of the population.

Factors considered in this selection process included:

- Location of the incinerator
- Local land use
- Local water use
- Existing ambient background surface-water and soil pollutant concentrations
- Transport modeling results
- Relative toxicity of emitted pollutants
- Persistence and mobility of pollutants

7.2 THE PROCESS OF KEY PATHWAY AND POLLUTANT SELECTION

An initial preliminary evaluation of all possible pathways was conducted to determine the potential for population exposure. The general framework for this process, illustrated in Figure 7-1, takes the form of a decision network designed to clearly identify the key exposure pathways and the pollutants likely to be associated with those pathways.

The first step is to evaluate the emission, dispersion, and deposition modeling data to determine the likelihood and extent of human exposure. The distribution profile of emitted pollutants in each of the environmental media is contrasted with local land and water use activities to determine the likelihood of exposure through a given pathway. The exposed population analysis identifies those pathways that are not anticipated to result in significant human exposure, and accordingly, require no further analysis. The pathways associated with likely exposure are identified, and subsequently undergo a quantitative analysis to estimate the extent of pollutant transport through the environment and the magnitude of exposure to humans. This more detailed analysis of the magnitude of exposure is presented in Section 8, "Exposure Assessment."

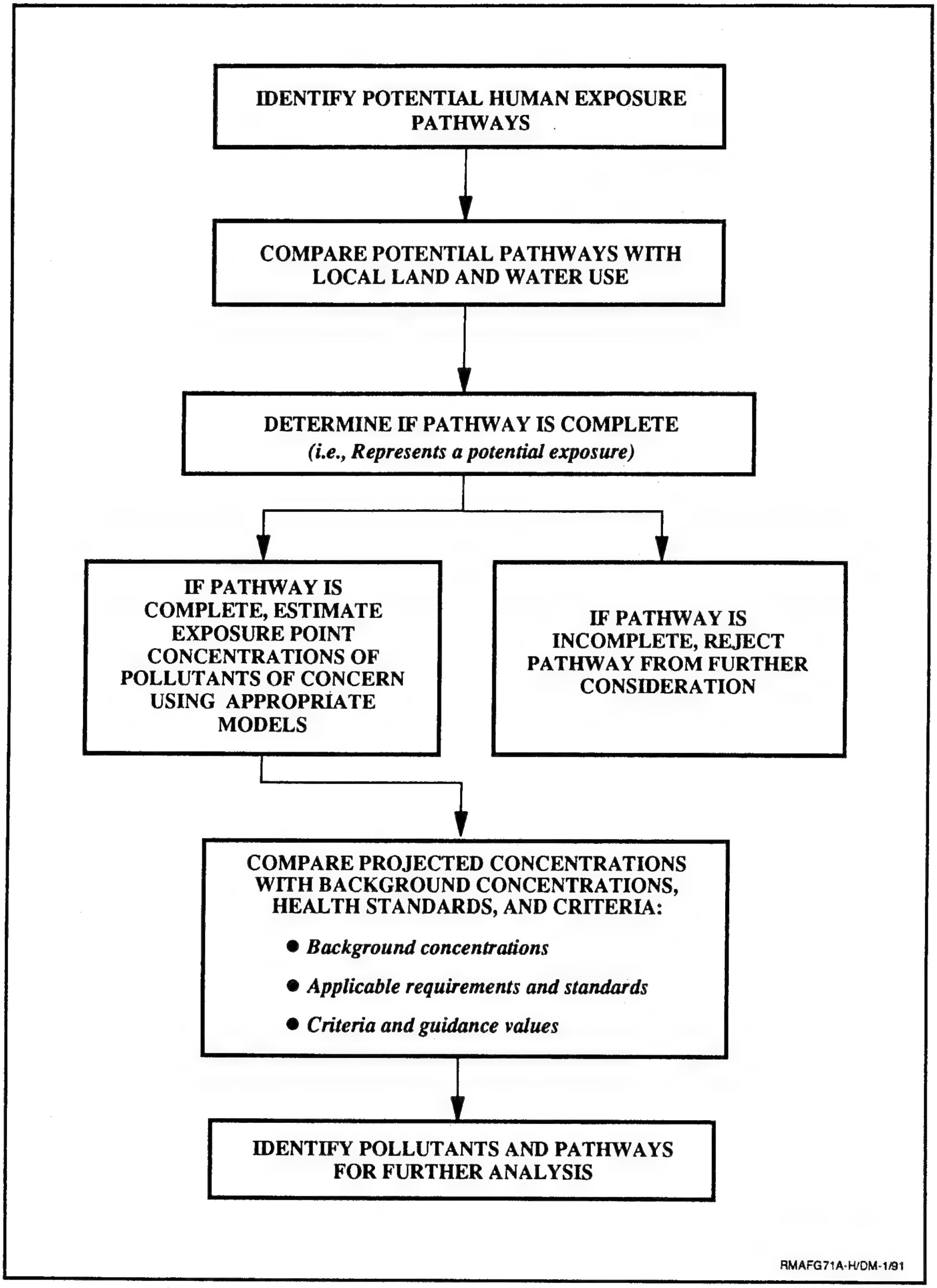

FIGURE 7-1 IDENTIFICATION AND CHARACTERIZATION OF HUMAN EXPOSURE PATHWAYS

The purpose of the pollutant selection process is to determine, for each identified pathway, those pollutants that represent a potential hazard to the exposed population. Screening factors that were considered in this determination include:

- Comparison of predicted media concentrations of each pollutant with existing background levels.
- Comparison of media concentrations with established indices of toxicity, such as Ambient Water Quality Criteria (AWQC) for the Protection of Human Health.
- Toxicological evaluation in the absence of established toxicity criteria.
- Determination of persistence and mobility characteristics specific to each pathway (e.g., air, water, soil, etc.).

The preliminary pathway and pollutant analysis is based on the assumption that pollutant transport and the resultant exposure to the population occur directly through air, and indirectly through soil and water. An assessment of the potential indirect exposure through food supply and other ingestion pathways is conducted after the fate of the emitted material in air, soils, and water has been estimated. Using ambient concentration data developed for each of these media, a determination is made of the potential for the biological medium to serve as a pathway of human exposure. Such biological media may include garden fruits and vegetables, agricultural crops, agricultural livestock, and recreationally caught fish. A discussion of those routes of exposure via food consumption is presented for each of their respective pathways (e.g., soil-vegetable consumption, water-fish consumption).

The subsections that follow present the rationale used for the determination of primary routes of exposure through air, soil, and water pathways.

7.3 AIR PATHWAY

The inhalation of pollutants predicted to be emitted to the atmosphere from the submerged quench incinerator stack represents a direct route of human exposure. As such, all

pollutants (both carcinogens and noncarcinogens), including criteria gases and particulates, were evaluated for their potential adverse health effects through inhalation.

The organic and trace metal pollutants in ambient air may exist either as a vapor or adsorbed onto stack gas particulate matter. For example, the majority of trace metals emitted from the combustion process are generally adsorbed on particulates in the gas stream, with the exception of the more volatile metals, such as mercury. Studies of the distribution of organic compounds between the solid (particulate) or vapor phase have yielded conflicting results. For example, some test data show a majority of organic compounds in the vapor phase, whereas other test data show a majority of organic compounds adsorbed onto the particulate matter (Czuczwa and Hites, 1985).

Given the equivocal nature of these studies, no judgment has been made in this risk assessment regarding the distribution of the pollutants among those adsorbed onto particulates available for deposition, or those in the vapor phase available for inhalation. It is therefore conservatively assumed for the soil and water pathways that the total mass of each pollutant emitted from the incinerator stack is adsorbed onto particulates for subsequent deposition on soil. Similarly, for the inhalation pathway, the total mass of each pollutant emitted is assumed to be in the vapor phase. The pollutants selected for evaluation by the inhalation pathway are listed in Table 7-1.

7.4 SOIL PATHWAY

Both organic and inorganic pollutants adsorbed onto the particulate emissions from the SQI reach the soil principally through either wet or dry deposition. Once incorporated into the soil, the pollutants are available for transport to human receptors through several pathways, including:

- Direct ingestion of soil
- Ingestion of locally or home grown agricultural products
- Consumption of meat and dairy products from locally raised animals
- Dermal absorption

Table 7-1

List of Pollutants Selected for Inhalation Pathway Evaluation

Organics

- Acetone
- Acetonitrile
- Acrylonitrile
- Aldrin
- Atrazine
- Benzaldehyde
- Benzene
- Benzofuran
- Benzoic Acid
- Benzonitrile
- Biphenyl
- Bromomethane
- Carbazole
- Carbon Tetrachloride
- Chlorobenzene
- 4-Chlorobiphenyl
- 4,4-Chlorobiphenyl
- Chloroform
- 4-Chlorophenylmethylsulfone
- 4-Chlorophenylmethylsulfoxide
- p,p-DDE
- p,p-DDT
- Dibenzofuran
- Dichlorobenzenes (total)
- 1,4-Dichlorobenzene
- 1,1-Dichloroethene
- 1,2-Dichloroethene
- 1,2-Dichloropropane
- Dieldrin
- DiisopropylMethylphosphonate
- 1,3-Dimethylbenzene
- Dimethyldisulfide
- Dimethyl Methylphosphonate
- Dimethylphosphate
- Dioxins/Furans (EPA TEFs)
- Dithiane
- Endrin
- Ethylbenzene
- Hexachlorobenzene
- Hexachlorocyclopentadiene
- Isodrin
- Malathion
- Methanol
- Methyl Chloride
- Methylene Chloride
- 4-Nitrophenol
- PAHs
  - Acenaphthalene
  - Acenaphthene
  - Benzo(a)pyrene
  - Chrysene
  - Dibenzo(a,h)anthracene
  - Fluoranthene
  - Fluorene
  - Phenanthrene
  - Pyrene
- Parathion
- Pentachlorobenzene
- Phenol
- Pyridine
- Quinoline
- Styrene
- Supona
- Tetrachlorobenzene
- Tetrachloroethene
- Toluene
- Trichlorobenzene
- Trichloroethene
- Urea
- Vapona
- Vinyl Chloride
- Xylene

Inorganics

- Aluminum
- Ammonia
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Calcium
- Chromium (III)
- Chromium (VI)
- Cobalt
- Copper
- Cyanogen
- Hydrogen Cyanide
- Iron
- Lead
- Lithium
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Phosphate
- Potassium
- Selenium
- Silicon
- Silver
- Sodium
- Strontium
- Thallium
- Tin
- Titanium
- Vanadium
- Yttrium
- Zinc

Criteria Pollutants/Acid Gases

- Carbon Monoxide
- Hydrogen Chloride
- Hydrogen Fluorides
- Nitric Acid
- Nitrogen Dioxide
- Particulate Matter
- Sulfur Dioxide
- Sulfuric Acid Mist

7.4.1 Potential Routes of Exposure

Based on local land use and population activity patterns in the vicinity of the Rocky Mountain Arsenal, the anticipated routes of exposure through the soil pathway are discussed in the subsections that follow.

7.4.1.1 Dermal Absorption Through Soil Contact

Exposure to pollutants incorporated into soils may result from direct contact with and subsequent absorption through the skin. The degree of exposure is largely dependent on the concentration of the pollutant in the soil, the absorption rate through the skin, and the frequency of contact with the soil. Dermal exposure is expected to occur in both child and adult exposure scenarios. Home gardens and agricultural activities are common in the area near the proposed site and represent one of the principal dermal exposure routes for adults. Adult dermal exposure is evaluated in Subsection 8.2.3 of the exposure assessment. Children are expected to play outside and come in contact with soil. Dermal exposure of children is evaluated in Subsection 8.3.3.

7.4.1.2 Soil and Dust Ingestion

Adults and children may inadvertently ingest soil adhering to hands during work, gardening, or play. Consequently, soil and dust ingestion are considered potential routes of exposure for adults and children. These pathways are evaluated in Section 8.

7.4.1.3 Consumption of Vegetables From A Typical Home Garden

The exposure resulting from the consumption of vegetables from a typical home garden has been evaluated in the exposure assessment (Subsection 8.2.2.1) for the following reasons:

- The prevalence of home gardens within a 5-kilometer radius of the proposed site.

- The potential for vegetables to accumulate certain pollutants from the soil or for the pollutant to adhere to plant surfaces.

7.4.1.4 Consumption of Milk

Dairy cattle are raised in the vicinity of the proposed SQI facility. The potential exists for bioconcentration of some pollutants in the milk of dairy livestock through contaminated feed ingestion, and local residents and farmers are anticipated to consume some home- or locally-produced milk. Therefore, exposure resulting from the consumption of cow's milk is evaluated in Subsection 8.2.2.2.

7.4.1.5 Consumption of Beef Products

In addition to dairy cattle, livestock may also be reared for beef consumption. Beef production is regarded as a potential mechanism of indirect human exposure to pollutants emitted from hazardous waste incinerators and resource recovery facilities (EPA, 1990a). A quantitative exposure assessment is presented for this pathway in Subsection 8.2.2.2.

7.4.2 Selection of Pollutants For Soil Pathway

To select pollutants of concern in the soil pathway, conservative pollutant soil concentrations resulting from SQI stack emissions were predicted and then compared to existing background data. This screening is done only for inorganics since organic background data were not available. The following equation was used to predict conservative soil concentrations of the inorganics:

$$CS = \frac{DR * AT * CF}{BD * D}$$

Where:

CS	=	Total pollutant concentration in soil due to deposition from facility (mg/kg)
DR	=	Pollutant deposition rate ($g/m^2/yr$)
AT	=	Accumulation time (2-year lifetime of incinerator unit)
BD	=	Bulk density of soil (1,425 kg/m^3)
D	=	Mixing depth (0.01 m) - the depth of the soil in which the element is retained and presumed to be equally distributed
CF	=	Conversion factor (1,000 mg/g)

The soil bulk density was based on an average bulk density value for various soil types that occur in the vicinity of Rocky Mountain Arsenal (Price, 1990).

In estimating soil concentrations for this initial screening analysis, several conservative assumptions were made:

- Soil concentrations were calculated using the upper range (i.e., sensitivity case) emission estimates and, consequently, overestimated the probable soil concentrations.
- Soil concentrations were calculated for the location of maximum total (wet and dry) deposition. This represents the maximum possible soil pollutant concentrations to which a potential human receptor could be exposed.
- Pollutants were assumed to be distributed equally throughout the soil to a depth of only 1 centimeter (0.01 m). This maximizes soil concentrations by at least one order of magnitude (in the more detailed analysis in Section 8, a soil depth of 10 to 20 cm was used, which results in a more plausible pollutant soil concentration).

Soil concentrations of inorganic chemicals based on maximum emission rates and which were used in the initial screening process are presented in Table 7-2. Appendix 8A

Table 7-2

Comparison of Predicted Inorganic Soil Concentrations Due to Submerged Quench Incinerator Emissions with Existing Background Levels

Pollutant	2-year Soil Concentration (1 cm) Due to Incinerator Emissions (mg/kg)	Mean Background[a] Soil Concentration (mg/kg)	Soil Concentration:[f] Mean Background Ratio
Inorganics			
Aluminum	0.018	15,358.0	0.00
Antimony[d]	0.08	ND	NA
Arsenic[b,d]	0.01	4.9	0.00
Barium	13.00	131.0	0.10
Beryllium[b,d]	0.00	6.1	0.00
Boron	0.03	29.0	0.00
Cadmium	0.00	0.58	0.00
Calcium	0.21	6,379.0	0.00
Chromium (total)	0.00	18.0	0.00
Chromium (VI)[c]	0.00	1.8	0.00
Cobalt	0.00	7.2	0.00
Copper[d]	4.50	12.0	0.38
Iron	0.06	16,424.0	0.00
Lead[b,d]	0.02	16.0	0.00
Lithium	0.00	10.0	0.00
Magnesium	0.17	2,673.0	0.00
Manganese	0.01	180.0	0.00
Mercury[d,e]	0.08	0.1	0.77
Molybdenum	0.01	14.0	0.00
Nickel	0.02	20.0	0.00
Phosphate	3.48	460.0	0.00
Potassium	1.79	1,564.0	0.00
Selenium[d]	6.50	0.97	6.71
Silicon	0.13	300,000.0	0.00
Silver[d]	0.77	8.3	0.09
Sodium[g]	392.98	740.0	0.53[g]
Strontium	0.00	45.0	0.00
Thallium[d]	0.08	1.2	0.06
Tin	0.01	109.0	0.00
Titanium	0.00	2,600.0	0.00
Vanadium	0.00	39.0	0.00
Yttrium	0.00	25.0	0.00
Zinc	0.02	35.0	0.00

[a]WESTON, Inc. Draft Background Geographical Characterization Report, Rocky Flats Plant, Golden, Colorado. Prepared by Roy F. Weston, Inc., Lakewood, Colorado, December, 1989.
[b]Carcinogen by oral route of administration (EPA, 1990b).
[c]Assumed 10% of chromium (total).
[d]Selected as a contaminant of concern for soil pathways analysis.
[e]Will be evaluated by dermal route of exposure through the soil pathway.
[f]Values shown as 0.00 were <0.01 because of rounding off to nearest one-hundredth.
[g]Eliminated as a contaminant of concern based on its low toxicity potential.
NA - Not applicable
ND - Not detected

presents the derivation of soil concentrations for both organics and inorganics selected for detailed evaluation in the exposure assessment (Section 8).

To determine if emissions from the SQI facility would elevate the concentrations of inorganics in the soil, the conservatively predicted levels were compared with local average soil background concentrations measured at the Rocky Flats facility (WESTON, 1989; Table 7-2). Inorganic pollutants with predicted soil concentrations of 1 percent or more of the background levels (i.e., had a predicted soil to background ratio greater than 0.01), were selected as pollutants of concern. Based on this criterion, the following metals were eliminated from all exposure routes of concern in the soil:

- Aluminum
- Boron
- Cadmium
- Calcium
- Chromium III
- Chromium VI
- Cobalt
- Iron
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Phosphate
- Potassium
- Silicon
- Strontium
- Tin
- Titanium
- Vanadium
- Yttrium
- Zinc

Although sodium was greater than 1 percent of background levels, it was dropped as a pollutant of concern through the soil pathway due to its relatively low toxicity.

Metals classified as carcinogens by the oral route (arsenic, beryllium, and lead) were selected even if their predicted soil level met the criterion for exclusion. Metals known to be carcinogenic only by the inhalation route (cadmium, chromium VI, and nickel) were screened from the soil pathway (but were included in the inhalation pathway) on the basis of the background criteria.

All volatile organic compounds (VOCs) were excluded from the soil pathway based on the following reasoning:

- VOCs are likely to be emitted as vapors.
- VOCs are unlikely to be deposited in soils following their emission.
- VOCs are unlikely to be persistent in soils, if deposited.

For purposes of this screening procedure, a VOC is defined as any chemical (carcinogen or noncarcinogen) with a vapor pressure greater than 1E+02 mm Hg and/or Henry's Law constants greater than 1E-03 atm-m^3/mol (Lyman et al., 1982). The vapor pressure criterion was derived from inspection of the range of vapor pressures of chemicals that EPA classifies as volatiles (EPA, 1986a).

All other organic compounds predicted in the emissions list were included for evaluation in the final soil pathway. Criterion pollutants and acid gases were excluded on the basis of their physical state (gas) and were evaluated only in the inhalation pathway. The final list of contaminants that were evaluated for the soil pathway are presented in Table 7-3.

7.5 SURFACE WATER PATHWAY

There were no waterbodies designated for drinking water use within a 10-km radius of the SQI; hence, this pathway was not considered in the risk assessment. Several surface water bodies were identified near the proposed site that provide a potential for indirect exposure to contaminants through the ingestion of fish.

Four small waterbodies designated for recreational fishing were determined to be located approximately 8 km west of the SQI and were within the predicted deposition area.

- Clear Creek Pond
- Engineers Lake
- Rotella Park Pond
- Grandview Ponds 1-4

Engineers Lake was selected as the body of water for evaluation of the fish consumption pathway for the following reasons:

Table 7-3

List of Pollutants Selected for Soil Pathway Evaluation

Organics

- Acetonitrile
- Aldrin
- Atrazine
- Benzaldehyde
- Benzofuran
- Benzoic Acid
- Benzonitrile
- Carbazole
- 4-Chlorobiphenyl
- 4,4-Chlorobiphenyl
- 4-Chlorophenylmethylsulfone
- 4-Chlorophenylmethylsulfoxide
- p,p-DDE
- p,p-DDT
- Dibenzofuran
- Dieldrin
- Diisopropyl Methylphosphonate
- 1,3-Dimethylbenzene
- Dimethylphosphate
- Dioxins/Furans (EPA TEFs)
- Dithiane
- Endrin
- Hexachlorobenzene
- Hexachlorocyclopentadiene
- Isodrin
- Malathion
- Methanol
- 4-Nitrophenol
- PAHs
  - Acenaphthalene
  - Acenaphthene
  - Benzo(a)pyrene
  - Chrysene
  - Dibenzo(a,h)anthracene
  - Fluoranthene
  - Fluorene
  - Phenanthrene
  - Pyrene
- Parathion
- Phenol
- Quinoline
- Supona
- Tetrachlorobenzene
- Trichlorobenzene
- Urea
- Vapona

Inorganics

- Antimony
- Arsenic
- Barium
- Beryllium
- Copper
- Lead
- Mercury
- Selenium
- Silver

- It was the closest waterbody to the facility boundary within the region of highest total deposition.
- It is a popular recreational fishery with a variety of top and bottom feeding species.
- Due to the relative size of its watershed area, its low outflow rates, and therefore long retention time, pollutant concentrations will be maximized so as to provide a conservative estimate of pollutant bioaccumulation in edible fish.

Contaminants for the surface water pathways were screened using a modification of the conservative Tier 1 analysis (EPA, 1986b). The contaminant water concentrations calculated with the Tier 1 method are based on the assumption that all contaminants emitted from the facility in a 1-year period are directly deposited into the lake. Furthermore, the model typically assumes that the emitted pollutant mass is concentrated into a water column with a volume equivalent to one square meter times its depth (in meters). This latter assumption is included to compensate for the large dilution factor associated with the high flow rates and short retention times of rivers and streams (for which the Tier 1 model is designed). Engineers Lake was assumed to have a relatively low turnover (0.5 yr), thus it would be too conservative to use the water column volume to calculate the water concentrations of contaminants. Therefore, WESTON has assumed the pollutants are distributed throughout the lake's volume. Nevertheless, the results will still be highly conservative given the assumptions that 50 percent of the total emitted contaminant mass (i.e., emitted over 1 year of operation) is deposited in the lake, and that the sensitivity case emission rates were used. Furthermore, no degradation or dilution was assumed in the Tier 1 screening. All VOCs were excluded from this analysis and from the detailed surface water pathway evaluation using the same criteria as employed for soils (Section 7.4.2). Refer to Appendix 7A for a detailed description of the calculations.

The surface water concentrations for each contaminant predicted from the Tier 1 analysis and the respective Ambient Water Quality Criteria (AWQC) for fish ingestion (EPA, 1986c) are presented in Table 7-4. Contaminants were selected for analysis in the surface water pathway if the predicted surface water concentrations for a given chemical exceeded 10

Table 7-4

Comparison of Predicted Surface Water Contaminant Concentrations in Engineers Lake with U.S. EPA AWQC for Protection of Human Health (Fish Consumption)

Pollutant	Predicted Annual Surface-Water Concentration (mg/L)	U.S. EPA AWQC[a] (mg/L)	Annual Surface-Water Concentration as Percent of U.S. EPA AWQC
Organics			
Fluoranthene	2.23 E-13	5.4E-02	4.13E-10
Pentachlorbenzene	1.64E-15	8.5E-02	1.93E-12
Tetrachlorobenzene	6.93E-16	4.8E-02	1.44E-12
Inorganics			
Antimony	6.58E-07	4.50E+01	1.46E-06
Chromium (III)	2.02E-09	3.43E+03	5.89E-11
Manganese	4.22E-08	1.00E-03	4.22E-03
Mercury	6.58E-07	1.46E-04	4.51E-01
Nickel	1.81E-07	1.00E-01	1.81E-04
Thallium	6.58E-07	4.80E-02	1.37E-03

[a]U.S. EPA. 1986c. Quality Criteria for Water 1986. Office of Water Regulations and Standards. EPA440/5-86-001. (Values shown are for fish comsumption).

percent of its respective health-based AWQC, or if the contaminant was carcinogenic by the oral exposure route. All contaminants evaluated were less than 10 percent of their health-based AWQC (Table 7-4) and, therefore, were excluded from further analysis. The list of pollutants selected for the surface water pathway appears in Table 7-5.

The Tier 1 surface water concentrations are overly conservative and are intended only for screening purposes. The Tier 2 method (Appendix 7A) is used to further evaluate surface water concentrations for the selected surface water pathway contaminants, taking into account deposition and dilution based on lake volume and outflow.

7.6 CONSUMPTION OF BREAST MILK

An important pathway for evaluation is the consumption of breast milk by infants nursing from mothers exposed directly or indirectly to facility emissions. Chemicals that bioaccumulate in fat are likely to achieve measurable levels in breast milk. Such compounds are organic chemicals with high lipid solubility and persistence in body tissues (i.e., long whole body half-lives). The limiting factor in evaluating these pollutants in this pathway is the lack of available half-life and tissue distribution data necessary to determine breast milk concentrations (refer to Appendix 8G for the equations and assumptions).

With the possible exception of lead, there are insufficient data to quantitate the transfer of metals into human breast milk. For lead, it may be possible to estimate transfer into breast milk if the blood lead levels of the mother are known. However, the estimation of blood lead levels is beyond the scope of this risk assessment.

All organic compounds were included in the evaluation of the breast milk consumption pathway for noncarcinogenic effects. Those organics classified as oral carcinogens were evaluated for carcinogenic risk by this pathway. Inorganics were excluded from this evaluation due to the insufficiency of data for estimating breast milk concentrations.

Table 7-5

List of Pollutants Selected for Surface Water Pathway Evaluation

Organics

Acetonitrile	Dieldrin	Benzo(a)pyrene
Aldrin	Diisopropyl Methylphosphonate	Chrysene
Atrazine	1,3-Dimethylbenzene	Dibenzo(a,h)anthracene
Benzaldehyde	Dioxins/Furans (EPA TEFS)	Fluorene
Benzofuran	Dithiane	Phenanthrene
Benzoic Acid	Endrin	Pyrene
Benzonitrile	Hexachlorobenzene	Parathion
Carbazole	Hexachlorocyclopentadiene	Phenol
4-Chlorobiphenyl	Isodrin	Quinoline
4,4-Chlorobiphenyl	Malathion	Supona
4-Chlorophenylmethylsulfone	Methanol	Trichlorobenzene
4-Chlorophenylmethylsulfoxide	4-Nitrophenol	Urea
p,p-DDE	PAHs	Vapona
p,p-DDT	Acenaphthanlene	
Dibenzofuran	Acenaphthene	

Inorganics

Aluminum	Chromium (VI)	Magnesium	Tin
Arsenic	Cobalt	Molybdenum	Titanium
Barium	Copper	Selenium	Vanadium
Beryllium	Iron	Silver	Yttrium
Boron	Lead	Strontium	Zinc
Cadmium	Lithium		

7.7 SUMMARY OF CRITICAL PATHWAYS AND ASSOCIATED POLLUTANTS OF CONCERN

The following list presents the critical routes of exposure for each environmental medium selected on the basis of the pollutant pathways analysis:

- Direct inhalation of pollutant emissions
- Ingestion of soil/house dust
- Dermal absorption through soil contact
- Consumption of vegetables from home gardens
- Consumption of milk
- Consumption of beef products
- Consumption of fish
- Consumption of breast milk by nursing infants

These pathways and their relationships to each other are presented in Figure 7-2.

For each of the foregoing critical routes of exposure, the associated pollutants of concern selected for the quantitative exposure assessment and risk characterization are presented in Table 7-6.

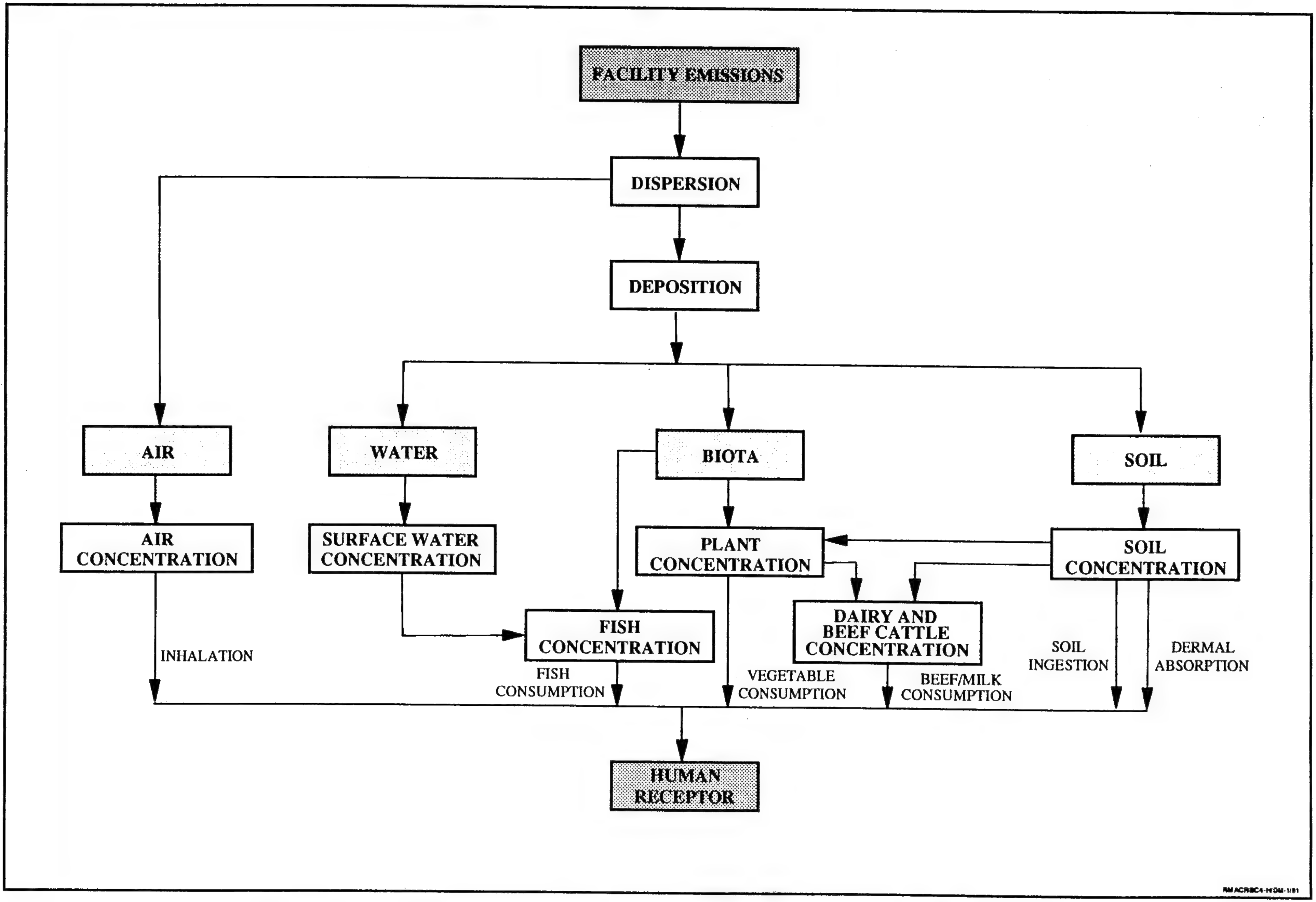

FIGURE 7-2 ENVIRONMENTAL PATHWAYS AND ROUTES OF EXPOSURE

Table 7-6

Final List of Pollutants and Respective Exposure Pathways to Be Evaluated

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
<u>Organics</u>								
Acetone	X							
Acetonitrile	X	X	X	X	X	X	X	X
Acrylontrile	X							
Aldrin	X	X	X	X	X	X	X	X
Atrazine	X	X	X	X	X	X	X	X
Benzaldehyde	X	X	X	X	X	X	X	X
Benzene	X							X
Benzofuran	X	X	X	X	X	X	X	X
Benzoic Acid	X	X	X	X	X	X	X	X
Benzonitrile	X	X	X	X	X	X	X	X
Biphenyl	X							X
Bromomethane	X							X
Carbazole	X	X	X	X	X	X	X	X
Carbon Tetrachloride	X							X
Chlorobenzene	X							X
4-Chlorobiphenyl	X	X	X	X	X	X	X	X
4,4-Chlorobiphenyl	X	X	X	X	X	X	X	X

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
Chloroform	X							X
4-Chlorophenyl methyl sulfone	X	X	X	X	X	X	X	X
4-Chlorophenyl methyl sulfoxide	X	X	X	X	X	X	X	X
p,p-DDE	X	X	X	X	X	X	X	X
p,p-DDT	X	X	X	X	X	X	X	X
Dibenzofuran	X	X	X	X	X	X	X	X
Dichlorobenzenes (total)	X							X
1,1-Dichloroethene	X							X
1,2-Dichloroethene	X							X
1,2-Dichloropropane	X							X
Dieldrin	X	X	X	X	X	X	X	X
Diisopropyl Methylphosphonate	X	X	X	X	X	X	X	X
1,3-Dimethylbenzene	X	X	X	X	X	X	X	X
Dimethyldisulfide	X							X
Dimethyl methylphosphonate	X	X	X	X	X	X	X	X
Dimethyl phosphate	X	X	X	X	X	X	X	X

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
Dioxins/Furans	X	X	X	X	X	X	X	X
Dithiane	X	X	X	X	X	X	X	X
Endrin	X	X	X	X	X	X	X	X
Ethylbenzene	X							X
Hexachlorobenzene	X	X	X	X	X	X	X	X
Hexachlorocyclopentadiene	X	X	X	X	X	X	X	X
Isodrin	X	X	X	X	X	X	X	X
Malathion	X	X	X	X	X	X	X	X
Methanol	X	X	X	X	X	X	X	X
Methyl Chloride	X							X
Methylene Chloride	X							X
4-Nitrophenol	X	X	X	X	X	X	X	X
PAHs								
Acenaphthalene	X	X	X	X	X	X	X	X
Acenaphthene	X	X	X	X	X	X	X	X
Benzo(a)pyrene	X	X	X	X	X	X	X	X
Chrysene	X	X	X	X	X	X	X	X
Dibenzo(a,h) anthrocene	X	X	X	X	X	X	X	X
Fluoranthene	X	X	X	X	X		X	X

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
Fluorene	X	X	X	X	X	X	X	X
Phenanthrene	X	X	X	X	X	X	X	X
Pyrene	X	X	X	X	X	X	X	X
Parathion	X	X	X	X	X	X	X	X
Pentachlorobenzene	X	X	X	X	X		X	X
Phenol	X	X	X	X	X	X	X	X
Pyridine	X							X
Quinoline	X	X	X	X	X	X	X	X
Styrene	X							X
Supona	X	X	X	X	X	X	X	X
Tetrachlorobenzene	X	X	X	X	X		X	X
Tetrachloroethene	X							X
Toluene	X							X
Trichlorobenzene	X	X	X	X	X	X	X	X
Trichloroethene	X							X
Urea	X	X	X	X	X	X	X	X
Vapona	X	X	X	X	X	X	X	X
Vinyl Chloride	X							X
Xylene	X							X

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
<u>Inorganics</u>								
Aluminum	X					X		
Ammonia	X							
Antimony	X	X	X	X	X		X	
Arsenic	X	X	X	X	X	X	X	
Barium	X	X	X	X	X	X	X	
Beryllium	X	X	X	X	X	X	X	
Boron	X					X		
Cadmium	X					X		
Calcium	X							
Chromium (III)	X							
Chromium (VI)	X					X		
Cobalt	X					X		
Copper	X	X	X	X	X	X	X	
Cyanogen	X							
Hydrogen Cyanide	X							
Iron	X					X		
Lead	X	X	X	X	X	X	X	
Lithium	X					X		

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
Magnesium	X					X		
Manganese	X							
Mercury	X	X	X	X	X		X	
Molybdenum	X					X		
Nickel	X							
Phosphate	X							
Potassium	X							
Selenium	X	X	X	X	X	X	X	
Silicon	X							
Silver	X	X	X	X	X	X	X	
Sodium	X							
Strontium	X					X		
Thallium	X	X	X	X	X		X	
Tin	X					X		
Titanium	X					X		
Vanadium	X					X		
Yttrium	X					X		
Zinc	X					X		

Table 7-6
(continued)

Pollutants	Inhalation	Vegetable Consumption	Milk Consumption	Beef Consumption	Soil/Dust Ingestion	Fish Consumption	Dermal Absorption	Breast Milk Ingestion
<u>Criteria Pollutants/ Acid Gases</u>								
Carbon Monoxide	X							
Hydrogen Chloride	X							
Hydrogen Fluoride	X							
Nitric Acid	X							
Nitrogen Dioxide	X							
Particulate Matter	X							
Sulfur Dioxide	X							
Sulfuric Acid Mist	X							

X = Pollutant is of potential concern through this exposure route or pathway.

SECTION 7

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SECTION 8

EXPOSURE ASSESSMENT

8.1 INTRODUCTION

The goal of this section is to predict the potential exposure concentrations and the daily intakes for all of the identified pathways and pollutants under average expected (base case) emissions conditions. This section incorporates information from each of the preceding sections with site-specific information such as meteorological conditions, land use patterns, agricultural practices, etc., in order to predict the pollutant levels to which "hypothetical" individuals would be exposed. Daily intakes of pollutants were estimated for each of the individuals and were used in the estimation of risk, based on the toxicity values presented in Section 9.

Dispersion and deposition modeling, presented in Section 6, identified how pollutants were distributed in the area surrounding the SQI. Dispersion modeling identified the ambient air concentrations of the pollutants, and deposition modeling identified the pollutant deposition rates under both dry and wet deposition conditions. This information was integrated with information concerning land uses surrounding the proposed SQI on RMA to select hypothetical human receptors for the exposure assessment.

8.1.1 Characterization of Exposure Scenarios

Numerous potential exposure scenarios are possible in the study area surrounding the proposed SQI at RMA. The objective of this assessment is to calculate the potential risk to a reasonable maximally exposed individual (RMEI). "Reasonable maximum exposure" is defined by the EPA as "the highest exposure that is reasonably expected to occur at a site" (EPA, 1989a). However, because the results of the modeling effort indicate varying patterns of wet deposition, dry deposition, and ambient air concentrations, both within and outside the arsenal boundaries, it is difficult to define "a priori" an absolute RMEI that represents

the maximally exposed person. Therefore, to meet the requirements of the Final Decision Document (Woodward-Clyde, 1990a), four reasonable maximum exposure scenarios were evaluated in the risk assessment. The scenario(s) ultimately yielding the greatest carcinogenic risk and noncarcinogenic health effects will be used as the basis to assess numerical chemical emissions limits for the SQI.

The scenarios presented below represent hypothetical current use conditions. No future use conditions were evaluated since hypothetical exposures in this case would not likely exceed any present use exposures; this is based on the assessment that pathways of exposure and areas of maximum effect of emissions would not be different from any of the present use conditions assessed. The four potential RMEIs were characterized as:

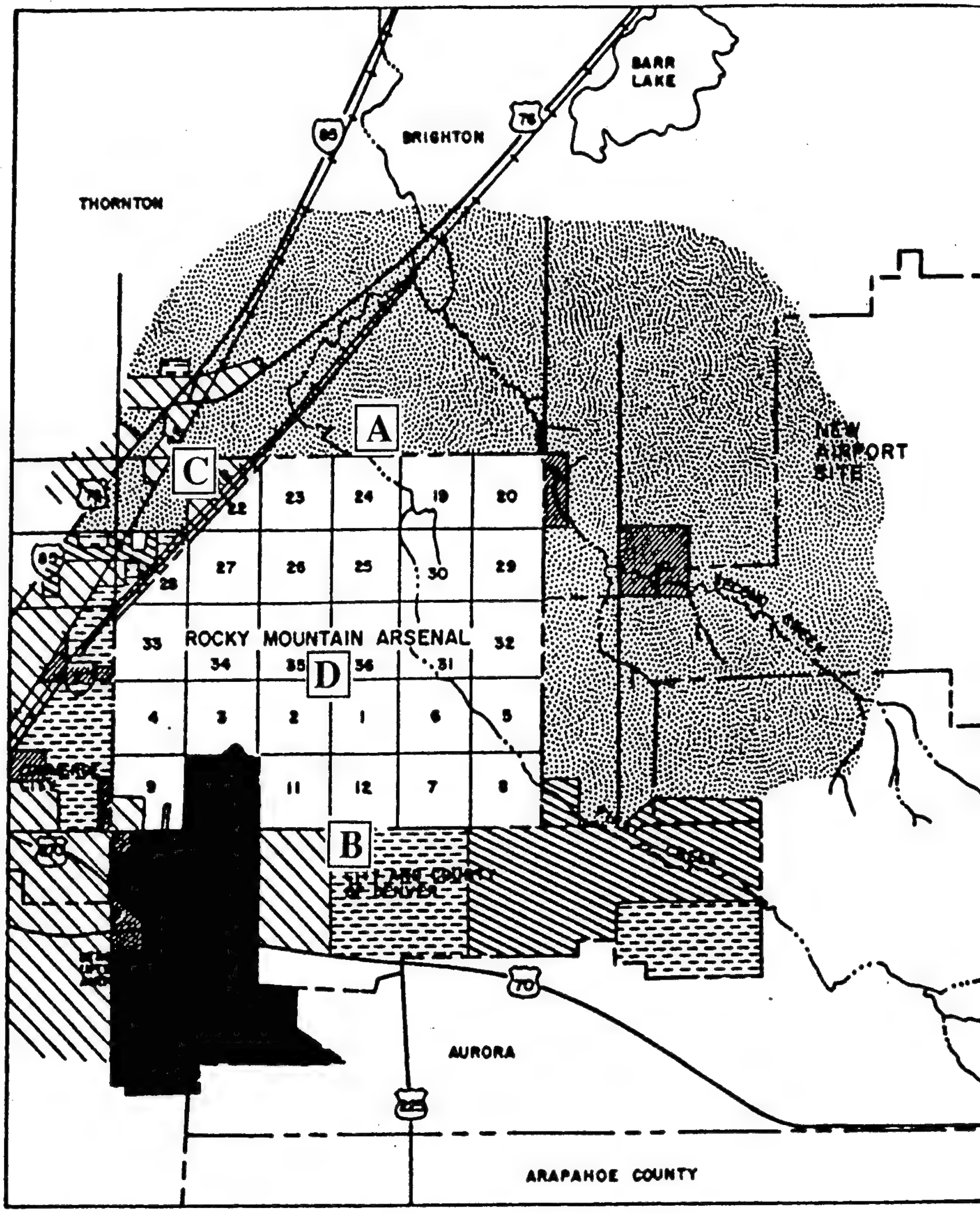
- Resident A
  A hypothetical individual currently living within the off-site residential area where inhalation and dry deposition will be maximal (i.e., just north of the fenceline).

- Resident B
  A hypothetical individual currently living within the off-site residential area where total deposition (dry plus wet) is maximal (i.e., just south of the property fenceline).

- Farmer
  A hypothetical individual currently living on a local cattle farm where total deposition is highest for that land use (i.e., just northwest of site).

- On-site Worker
  A maintenance worker on-site exposed to area-weighted air and soil concentrations of pollutants as determined from the modeling results.

The respective locations of these RMEIs are approximated on the site diagram in Figure 8-1. The deposition values, isopleths, and specific locations were discussed in more detail in Section 6. The following text describes in detail the exposure routes and general assumptions for each scenario.



A - AREA OF MAXIMUM DRY DEPOSITION AND MAXIMUM GROUNDLEVEL AMBIENT AIR CONCENTRATION (RESIDENT A)

B - AREA OF MXIMUM TOTAL DEPOSITION (RESIDENT B)

C - AREA OF MAXIMUM TOTAL DEPOSITION FOR LOCAL CATTLE FARM (FARMER)

D - ON-SITE MAINTENANCE WORKER EXPOSED TO AREA WEIGHTED TOTAL DEOSITION AND GROUNDLEVEL AMBIENT AIR CONCENTRATIONS

NORTH

0 1 2 3

SCALE IN MILES

COMMERCIAL AND SERVICE	RESIDENTIAL
AGRICULTURE	TRANSITIONAL
INDUSTRIAL	STAPLETON INTERNATIONAL AIRPORT

SOURCE: EBASCO, 1990

RMAFG81A-H/DM-1/91

FIGURE 8-1 GENERAL LOCATIONS OF REASONABLE, MAXIMALLY-EXPOSED INDIVIDUALS BASED UPON AMBIENT AIR AND DEPOSITION MODELING.

Resident-A Scenario -- Resident-A is assumed to be living in a residential area where off-site dry deposition and ambient air concentrations are maximal. This area falls outside thearsenal boundaries (off-site) since individuals are not permitted to live on the grounds of the arsenal (U.S. Army, 1990a). The maximum off-site dry deposition and air concentration occur at the same location, directly north of the arsenal (i.e., bearing 010° and 2,000 meters from the proposed SQI). The site-specific contribution of wet deposition at this location also was included.

Resident-A is assumed to be exposed to all pathways of exposure listed for the air (Subsection 7.3), soil (Subsection 7.4), and surface water (Subsection 7.5) pathways. The air pathway represents the route of exposure for pollutant inhalation. The soil pathway includes the following routes of exposure:

- Soil/dust ingestion
- Dermal absorption
- Vegetable consumption
- Milk and beef consumption

The surface water pathway includes the fish ingestion route of exposure. The milk and beef that are consumed are assumed to be obtained from a local farm, which is the same farm evaluated under the Farmer Scenario.

Mother's milk ingestion and inhalation are the only pathways evaluated for infants (all resident and farmer scenarios).

Resident-B Scenario -- Resident-B is assumed to be living in a residential area where off-site wet (and total) deposition is maximal. As with the Resident-A scenario, Resident-B is assumed to be living off-site. The Resident-B location falls directly south of the arsenal (i.e., bearing 180° and 6,000 meters from the proposed SQI). Resident-B is assumed to be exposed through the same pathways of exposure through which Resident-A is exposed.

Farmer Scenario -- For the Farmer scenario, it was assumed that a cattle farm is located where off-site deposition (wet and dry) and air concentration are highest for that land use. This location was chosen based on areas where cows were observed grazing, and is located off-site (i.e., bearing 300° and 2,500 meters from the proposed SQI). It was assumed that the individual at this location is a subsistence farmer, and so not only raises beef and dairy cattle, but also grows cattle feed and vegetables. The pathways of exposure evaluated under the Farmer scenario are the same as those being evaluated for the Resident-A and Resident-B scenarios.

Worker Scenario -- Since the highest air concentration of pollutants as well as maximum deposition and consequent soil concentrations were predicted to occur on the arsenal site proper, a scenario that evaluates a worker at the arsenal was developed. Maximal exposure would occur to those workers who spend the greatest amount of time outdoors. Maintenance workers on the road and the grounds crew spend 90 percent of a working year outside, and thus are the workers at the arsenal that have the highest potential for exposure. Their work activities include road repair and grading, building or fixing culverts and drainage ditches, building or tearing down fences, snow removal, etc. They have complete access to the entire arsenal (1,700 acres), and could be working in any area of the arsenal at any given time (U.S. Army, 1990b). Thus, area-weighted total deposition rates and air concentrations for the entire arsenal were used in estimating risk to the worker.

The routes of exposure evaluated under the Worker scenario include inhalation, soil/dust ingestion, and dermal absorption from soil. These are the only routes through which exposure is expected to occur to the worker.

8.1.2 General Approach

The following subsections evaluate the potential exposure to pollutants through each of the exposure routes under consideration and are summarized in Table 8-1. The estimated exposure concentrations were calculated using the base case emission rates for each of the pollutants (refer to Section 5). Pollutant intakes expressed in milligram of pollutant per

Table 8-1

Overview of Exposure Scenarios

Resident-A Scenario	Resident-B Scenario	Farmer Scenario	Worker Scenario
Receives maximum off-site inhalation exposure.	Receives inhalation determined at the maximum wet/total deposition location.	Receives inhalation determined at the farm location.*	Receives inhalation determined at the arsenal.
Eats vegetables grown at the maximum off-site dry deposition location.	Eats vegetables grown at the maximum off-site wet/total deposition location.	Eats vegetables grown at the farm location.*	Contacts soil at the arsenal.
Eats beef and drinks milk from cattle raised at the farm location.*	Eats beef and drinks milk from cattle raised at the farm location.*	Eats beef and drinks milk from cattle raised at the farm location.*	Ingests indoor dust and outdoor soil at the arsenal.
Contacts soil at the maximum off-site dry deposition location.	Contacts soil at the maximum off-site wet/total deposition location.	Contacts soil at the farm location.*	
Ingests indoor dust and outdoor soil at the maximum off-site dry deposition location.	Ingests indoor dust and outdoor soil at the maximum off-site wet/total deposition location.	Ingests indoor dust and outdoor soil at the farm location.*	
Eats fish from Engineers Lake.	Eats fish from Engineers Lake.	Eats fish from Engineers Lake.	
Consumes breast milk as an infant.	Consumes breast milk as an infant.	Consumes breast milk as an infant.	

* A farm was assumed to be located where deposition (wet and dry) and air concentration are highest for that land use.

kilogram of body weight per day (mg/kg/day) were calculated for an adult (Subsection 8.2), a child age 1 to 6 years, and an infant age 0 to 1 years (Subsection 8.3). Because of their behavioral patterns (e.g., frequent hand-to-mouth contact, frequent outdoor play) and their small body size, small children might have the potential for a greater intake of pollutants than an average adult and, therefore, might be at a higher risk. Similarly, breast feeding infants, because of their small body size, may be at risk due to the concentration of pollutants in mother's milk.

The calculation of exposure doses is a complex process and involves numerous variables that must be estimated. In calculating exposure doses, WESTON, in cooperation with RMA Project Management Personnel and EPA Region VIII, developed exposure factors consistent with the following documents:

- Ebasco Services, Inc. 1990. Final Human Health Exposure Assessment for the Rocky Mountain Arsenal. Volume IV. Preliminary Pollutant Limit (PPLV) Methodology. Version 4.1. September, 1990. Contract No. DAAA15-88-0024.

- ESE (Environmental Science & Engineering, Inc.), Harding Lawson Associates, and Applied Environmental, Inc. 1989. Technical Support for Rocky Mountain Arsenal. Offpost Operable Unit Endangerment Assessment/Feasibility Study with Applicable and Appropriate Requirements. Volume I. Draft Final Report Version 2.1. March 1989. Contract No. DAAA15-88-D-0021.

- Woodward-Clyde Consultants. 1990. Draft Public Health Risk Assessment Report. Submerged Quench Incinerator, Task IRA-2, Basin F Liquids Treatment Design. Version 2.1. January 1990. Contract No. DAAA15-88-D-0022/0001.

When exposure factors were available in these documents, they were used. If appropriate exposure factors were not available, or there were inconsistencies between available factors and the identified exposure scenarios, then standard EPA references or other relevant references were used for their selection. In some cases, variables specific to the RMA area were obtained from local agencies (e.g., types of livestock, types of forage, crop yield, growing time for vegetables, etc.). Tables that present the predicted intakes of pollutants

through the applicable exposure routes for adults, children, and infants are presented at the end of Section 8 .

The soil concentrations used in the estimation of pollutant intakes through soil-mediated exposure routes were based on pollutant deposition calculated for a 2-year facility lifetime. Two soil concentrations were calculated for pollutants of concern through soil-related pathways, one representing the maximum soil concentration (i.e., the concentration at the end of year 2), the other representing the average soil concentration over 70 years (an average lifetime). They are described in Appendix 8A. The average soil concentrations over the 70-year exposure period were used in calculating carcinogenic risk through all soil-mediated pathways for children and adults, since the calculation of carcinogenic risk is based on a 70-year lifetime exposure. Infants are exposed for only 1 year, during which exposure concentrations will be at a maximum. In order to prevent underestimating carcinogenic risk to the infant, maximum soil concentrations were used instead of average soil concentrations in calculating the mother's intake and resultant carcinogenic risk to the infant. Maximum soil concentrations also were used to calculate noncarcinogenic risk to an infant, child, or adult, since it is possible that any individual may be exposed to maximum soil concentrations. More detailed information on soil concentrations are presented in Appendix 8A.

The air pathway was evaluated for all of the pollutants of concern as identified in Section 7. The pollutants that were evaluated for the soil pathway were chosen based on the physical characteristics of chemicals as well as a comparison to background levels. This screening process is described in greater detail in Section 7. In screening pollutants for the surface water pathway, a worst case (Tier 1) approach was used to calculate surface water pollutant concentrations. However, in order to determine more realistic levels of exposure through the surface water pathway, a Tier 2 evaluation was conducted. The details of this methodology, including the predicted surface water concentrations of the pollutants of concern, are presented in Appendix 7A.

8.2 ROUTES OF EXPOSURE CONSIDERED FOR THE ADULT

The routes of exposure evaluated for adults are discussed below. All tables containing exposure doses calculated for the adult, based on the Resident-A, Resident-B, Farmer, and Worker exposure scenarios, are presented at the end of Section 8.

8.2.1 Adult Inhalation Exposure

As discussed in Section 7, inhalation exposure was estimated for all pollutants of concern. For the inhalation pathway, the total duration of exposure for an adult was assumed to be continuous over the facility lifetime. Thus, inhalation exposure to adults under the Resident-A, Resident B, and Farmer scenarios were assumed to occur for 365 days per year for 2 years. Inhalation exposure to workers would occur for 250 days per year, based on a 5-day work week for 50 weeks per year. It was assumed that indoor air exposure was equivalent to outdoor exposure. This assumption is likely to lead to an overestimation of exposure because indoor concentrations resulting from air-dispersed, outdoor-generated pollutants will most likely be lower than the outdoor concentrations.

Based on these assumptions, the following equation was used to calculate the estimated daily intake through inhalation:

$$EDI_{inh} = \frac{C_{air} \times BR \times EF}{BW \times F}$$

Where:

EDI_{inh} = Estimated daily intake through inhalation (mg pollutant/kg body weight/day)

C_{air} = Pollutant concentration in ambient air ($\mu g/m^3$)

BR = Breathing rate for an adult:

- 20 m^3/day - Resident-A, Resident-B, and Farmer scenarios (Woodward-Clyde, 1990)

- $10\ m^3$/day - Worker scenario (Ebasco, 1990)

EF = Exposure frequency:

- 365 days/yr - Resident-A, Resident-B, and Farmer scenarios
- 250 days/yr - Worker scenario

BW = Body weight for an adult, 70 kg (Ebasco, 1990)

F = Conversion factor: 10^3 μg/mg; 365 days/yr

Predicted ambient air concentrations for the Resident-A, Resident-B, Farmer, and Worker scenarios were calculated in the modeling analysis and are presented in Table 8-2. The estimated daily intakes through the inhalation exposure route are presented in Tables 8-3 and 8-4 for the Resident-A scenario, Tables 8-5 and 8-6 for the Resident-B scenario, Tables 8-7 and 8-8 for the Farmer scenario, and Tables 8-9 and 8-10 for the Worker scenario. (Tables are presented at the end of this section).

8.2.2 Adult Ingestion Exposure

The ingestion of vegetables, milk, beef, soil/dust, and fish are discussed in the following subsections. All of these ingestion routes of exposure were evaluated for the Resident-A, Resident-B, and Farmer scenarios. Only the soil/dust ingestion route was evaluated for the Worker scenario.

8.2.2.1 Vegetable Consumption

Vegetables and fruits from home vegetable gardens can be potentially contaminated by airborne pollutants emitted from the proposed SQI. Three locally grown food crops were selected to identify potential exposure to pollutants through vegetable/fruit ingestion. Carrots were selected to represent a root vegetable, lettuce to represent a leafy vegetable, and tomatoes to represent a fruiting vegetable or vine crop. Ingestion rates were based on the average daily consumption of these food groups. For example, the carrot ingestion rate

was based on the consumption of all root vegetables; the lettuce ingestion rate was based on the consumption of all leafy vegetables; and the tomato ingestion rate was based on the consumption of fruiting vegetables. This simplified the exposure calculation while taking into account all vegetables potentially consumed from household gardens. The ingestion rates used in this assessment were based on EPA (1990a) estimates.

For the Resident-A and Resident-B scenarios, it was assumed that 58 percent of all vegetables consumed were homegrown or obtained from a local source. This percentage is based on data for rural households (ESE et al., 1989). For the Farmer scenario it was assumed that 90 percent of all vegetables consumed were homegrown (EPA, 1990b).

Consistent with the analysis in this report of other soil-related exposure pathways, the contaminant soil concentrations were based on deposition determined over the 2-year life of the incinerator. Soil concentrations were calculated as described in Appendix 8A, using a mixing depth of 20 cm to account for soil cultivation (EPA, 1986a).

Pollutants may contaminate plants through two principal mechanisms: absorption through root uptake from contaminated soil and direct deposition on aboveground parts of the plants (leaves, fruits, stems). Deposition on the aboveground section of the plant (tomatoes and lettuce only) will occur primarily in the form of dry deposition, which will uniformly cover all exposed surfaces. It was conservatively assumed that all dry deposition on the plant surface during the growing season was retained and was not washed off by rain events. Dry deposition rates are presented in Appendix 8B, Tables 8B-8 through 8B-19. However, it was also assumed that wet deposition was not retained on the plant and ran off the plant surface to the ground, even though it is likely that some wet deposition would be retained on plants after a rain event. Although this is not a conservative assumption, it tends to offset the previous assumption that all dry deposition is retained on the plant surface.

The following subsections discuss the methodology that was used to calculate pollutant exposure through vegetable ingestion. The average and maximum daily intakes of pollutants through total vegetable ingestion are summarized in Tables 8-3 and 8-4 for the Resident-A

scenario, Tables 8-5 and 8-6 for the Resident-B scenario, and Tables 8-7 and 8-8 for the Farmer scenario. Intermediate calculations used to determine total vegetable intakes, as well as intakes for the individual vegetables are presented in Appendix 8B.

Root Vegetables -- The carrot, which is an edible taproot, served as a surrogate for root vegetables grown in home gardens. Thus, the carrot ingestion rate was based on the consumption of all root vegetables for the Farmer scenario. For the Resident-A and Resident-B scenarios, the root vegetable intakes were assumed not to include potatoes, since it is unlikely that residents would grow potatoes in their home gardens.

Carrots were assumed to accumulate pollutants only through uptake from the soil. The absorption of pollutants deposited on the leaves, and their subsequent translocation to the root, were assumed to be negligible (Wipf et al., 1982). It also was assumed that the carrots would be washed before being eaten, so that the adherence of soil to the carrots would not contribute to pollutant intake.

The general formulas used to calculate exposure through carrot ingestion include the calculation of the pollutant concentration in the carrot:

$$C_{Carrot} = C_{Soil} \times RUF;$$

and, the calculation of the estimated intake due to the consumption of carrots:

$$EDI_{Car} = \frac{C_{Carrot} \times IR \times HG \times F}{BW}$$

Where:

EDI_{Car} = Estimated daily intake due to consumption of carrots (mg pollutant/kg body weight/day), Appendix 8B

C_{Carrot} = Pollutant concentration in the carrot (mg/kg), Appendix 8B

C_{Soil} = Pollutant concentration in the soil (mg/kg), Appendix 8B

RUF	=	Root uptake factor (dimensionless), Appendix 8B
IR	=	Ingestion rate (wet weight), average adult daily consumption of root vegetables (EPA, 1990a):

- 11.7 g/day - Resident-A and Resident-B scenarios
- 65.3 g/day - Farmer scenario

HG	=	Fraction homegrown:

- 58% - Resident-A and Resident-B scenarios (ESE et al., 1989)
- 90% - Farmer scenario (EPA, 1990b)

F	=	Conversion factor, 10^{-3} kg/g
BW	=	Body weight, average adult (70 kg) (Ebasco, 1990)

The root uptake factor (RUF) is defined as the ratio of the concentration of the pollutant in the root (C_{root}) to the concentration in the soil (C_{soil}). The formulation of a RUF assumes that plant uptake is proportional to soil concentrations. The derivation of the RUFs used for this assessment is described in Appendix 8B.

<u>Calculation of Daily Intake</u> -- Factors used in the calculation of pollutant concentrations in carrots are summarized in Appendix 8B. The wet weight ingestion rates of 11.7 g/day for the Resident-A and Resident-B scenarios and 65.3 g/day for the Farmer scenario were calculated from dry weight ingestion rates for root vegetables (the former of which excludes potatoes) (EPA, 1990a), assuming a moisture content of 77.8 percent for potatoes and 88 percent for all other root vegetables (Baes et al., 1984). The ingestion rates were based on the average dry weight ingestion rates for individuals over the age of 13 years of 0.02 g/kg body weight/day and 0. 19 g/kg body weight/day, respectively. Average and maximum daily intakes of pollutants through root vegetable ingestion for the adult are summarized in Appendix 8B. Average and maximum daily intakes of pollutants through total vegetable ingestion (i.e., root, leafy, and fruiting vegetables) are summarized in Tables 8-3 and 8-4, Tables 8-5 and 8-6, and Tables 8-7 and 8-8 for the Resident-A, Resident-B, and Farmer scenarios, respectively.

Leafy and Fruiting Vegetables -- Consumption of leafy and fruiting vegetables grown in home gardens was represented by lettuce and tomatoes, respectively. Root uptake of pollutants from the soil and the surface deposition of pollutants on edible aboveground plant parts were used to determine the accumulation of pollutants by lettuce and tomatoes. The formulas used to calculate the exposure to pollutants through the ingestion of these vegetables are as follows:

$$C_{Tomato\ (Lettuce)} = C_{Surface} + C_{Uptake}$$

$$EDI_{Ing} = \frac{C_{Tomato\ (Lettuce)} \times IR_{Tomato\ (Lettuce)} \times HG \times F}{BW}$$

Where:

EDI_{Ing} = Estimated daily intake due to consumption of leafy vegetables or vine crops (mg pollutant/kg body weight/day), Appendix 8B

$C_{Tomato\ (Lettuce)}$ = Pollutant concentration in leafy or fruiting vegetables (mg/kg), Appendix 8B

$C_{surface}$ = Pollutant concentration in plant due to surface deposition (mg/kg), Appendix 8B

C_{Uptake} = Pollutant concentration in plant due to root uptake (mg/kg), Appendix 8B

$IR_{Tomato\ (Lettuce)}$ = Ingestion rate, daily consumption of leafy or fruiting vegetables (EPA, 1990a):

- 64 g/day - Tomatoes
- 11.9 g/day - Lettuce

HG = Fraction homegrown:

- 58% - Resident-A and Resident-B scenarios (ESE et al., 1989)
- 90% - Farmer scenario (EPA, 1990b)

F = Conversion factor, 10^{-3} kg/g

BW = Body weight, average adult (70 kg) (Ebasco, 1990)

Plant pollutant concentrations due to surface deposition and root uptake are presented and described in Appendix 8B.

<u>Calculation of Daily Intakes</u> -- Total pollutant concentrations in tomatoes and lettuce were determined by adding the concentrations due to deposition and root uptake and are summarized in Appendix 8B. The ingestion rates used for lettuce (11.9 g/day) and tomatoes (64 g/day) were wet weight ingestion rates for leafy and fruiting vegetables, respectively. These values were calculated from dry weight ingestion rates for leafy vegetables (0.008 g/kg body weight/day) and fruiting vegetables (0.06 g/kg body weight/day) for individuals over the age of 13 years (EPA, 1990a), assuming a moisture content of 95 percent for lettuce and 94 percent for tomatoes (Baes et al., 1984). Average and maximum daily intakes of pollutants for all exposure scenarios through tomato and lettuce ingestion for the adult are summarized in Appendix 8B. The estimated daily intake through total vegetable ingestion was calculated by the following equation:

$$EDI_{Veg} = (EDI_{Carrots} + EDI_{Tomatoes} + EDI_{Lettuce})$$

Average and maximum daily intakes of pollutants through total vegetable ingestion (i.e., root, leafy, and fruiting vegetables) are summarized in Tables 8-3 and 8-4, Tables 8-5 and 8-6, and Tables 8-7 and 8-8 for the Resident-A, Resident-B, and Farmer scenarios, respectively.

Several assumptions that contributed to the conservatism of the dosage estimates were made in the computation of pollutant exposure through vegetable ingestion. These assumptions included:

- No degradation of pollutants on plant surfaces via photolysis or volatilization occurred.
- Tomatoes and lettuce were not washed before consumption.

indirect human exposure to pollutants may occur when farm animals near the incinerator site consume feed and/or incidental soil during grazing or feeding. These pollutants may then be incorporated into beef or dairy products that are consumed by human receptors. The consumption of beef and dairy products was evaluated for the Resident-A, Resident-B, and Farmer scenarios.

Two farm products (milk and beef) were selected to investigate the potential for pollutant uptake by humans. The highest exposure would be expected for farmers who consume their own animals (beef) or animal products (milk). Exposure of the general public might occur if beef or dairy products were obtained from a local farmer, but would be expected to be lower than exposure for farmers. It was assumed that a subsistence farmer would home produce 100 percent of all meat and milk consumed. For the Resident-A and Resident-B scenarios, it was assumed that 5 percent of all meat and milk consumed was obtained from a local source.

Four major types of feed are consumed by dairy and beef cattle raised in the vicinity of RMA: hay, corn silage, grain, and pasture grass (Stanton, 1990). In addition, cattle in this area are fed a protein supplement. The dietary intakes of each type of feed for these animals are discussed in Appendix 8C. Although some beef and dairy cattle raised in the area are grazed, lactating dairy cows and finishing stock are not, and thus, the ingestion of pasture grass and incidental soil was not evaluated as part of the cattle diet. The cattle, as well as the cattle feed, were assumed to be raised at the same location for all scenarios. This location was chosen based on the area of highest deposition and air concentration where cows were observed grazing.

The methods used to calculate the pollutant concentrations in cattle feed were the same as those used for tomatoes and lettuce. They are described in Appendix 8C. These include the direct deposition of airborne pollutants on plant surfaces and root uptake of pollutants from soil.

The final step is to determine the human exposure due to the consumption of dairy and beef products. This was calculated as follows:

$$EDI_{\text{Milk and beef}} = \frac{C_{\text{Product}} \times IR \times F \times HG}{BW}$$

Where:

$EDI_{\text{Milk (beef)}}$	=	Estimated daily intake resulting from the ingestion of milk or beef (mg pollutant/kg body weight/day)
C_{Product}	=	Pollutant concentration in the farm product: milk or beef (mg/kg), Appendix 8C
$IR_{\text{Milk (beef)}}$	=	Ingestion rate, average daily adult consumption of milk or beef (g/day) (Fries, 1986; Pao et al., 1982)
HG	=	Fraction homegrown: • 5% - Resident-A and Resident-B scenarios • 100% - Farmer scenarios
F	=	Conversion factor, 10^{-3} kg/g
BW	=	Body weight, average adult (70 kg) (Ebasco, 1990)

Factors used to calculate pollutant concentrations in milk and beef are summarized in Appendix 8C. The average milk consumption rate for an adult was estimated to be 305 g/day (Fries, 1986), and the average beef consumption rate was estimated to be 66.8 g/day (Fries, 1986). The consumption rates of milk fat and beef fat are used in calculating dioxin intake (Appendix 8C). Since the fat content of whole milk is about 4 percent, the daily consumption equates to about 12 g of milk fat/day for an adult. Fat content varies greatly between different cuts of beef. However, the most recent available data show that the average percentage of beef fat ingested by adults is 22 percent (Fries, 1986). This translates

to an average daily ingestion of 14.7 g of beef fat/day. Average and maximum daily intake rates of pollutants through milk and beef consumption are presented in Tables 8-3 and 8-4 for the Resident-A scenario, Tables 8-5 and 8-6 for the Resident-B scenario, and Tables 8-7 and 8-8 for the Farmer scenario.

8.2.2.3 Soil/Dust Ingestion

The potential for oral intake of pollutants by older children and adults through soil/dust ingestion, although not as great as that for young children (Subsection 8.3), was evaluated.

Pollutant intake via soil/dust ingestion was calculated using the following formula:

$$EDI_{Soil/dust} = \frac{C_{Soil} \times IR_{Soil/dust} \times EF \times F}{BW}$$

Where:

$EDI_{Soil/dust}$ = Estimated daily intake due to soil/dust ingestion (mg pollutant/kg body weight/day)

C_{Soil} = Pollutant concentration in soil (mg/kg)

$IR_{Soil/Dust}$ = Ingestion rate, annual average adult daily ingestion of soil and dust:

- 0.1 g/day - Resident-A, Resident-B, and Farmer scenarios (EPA, 1990b)
- 0.05 g/day - Worker scenario (Ebasco, 1990)

EF = Exposure frequency:

- 365 days/year - Resident-A, Resident-B, and Farmer scenarios
- 225 days/year - Worker scenario (U.S. Army, 1990b)

F = Conversion factors: 10^{-3} kg/g, yr/365 days

BW = Body weight, average adult (70 kg) (Ebasco, 1990).

It was assumed that adults could be exposed to outdoor soils during a variety of outdoor activities such as farming, gardening, yard work, or maintenance work. Although exposure to a mixture of tilled and untilled soils might occur, the untilled soil (10-cm mixing depth) was used as a more conservative estimate of soil exposure. It was assumed that the concentrations of pollutants in indoor dusts were the same as those in the soil, since indoor dust that is associated with outdoor soil typically comes from tracking in soil from outdoor sources. This assumption was based on a review of several studies on lead that indicate a lack of consistency between outdoor soil and indoor dust concentrations, (i.e., lead concentrations were sometimes higher in house dust than in outdoor soil, while in other cases they were higher in soil (CDHS, 1987)). Predicted average and maximum concentrations for the pollutants of concern in the top 10 cm of soil are listed for the exposure scenarios in Appendix 8A. These concentrations are based on the total deposition for each scenario location.

An annual average soil/dust ingestion rate of 100 mg/day was assumed for adults under the Resident-A, Resident-B, and Farmer scenarios (EPA, 1990b). This soil/dust ingestion rate is based on a 365 day per year exposure. The worker was assumed to ingest 50 mg/day of soil/dust on those days when he is in direct contact with soil (Ebasco, 1990). It was assumed that a road and grounds crew worker would spend 90 percent of his time outside (U.S. Army, 1990b). This amounts to 225 days/year based on a 5-day work week for 50 weeks/year.

Average and maximum daily intakes of pollutants through soil/dust ingestion are presented in Tables 8-3 and 8-4 for the Resident-A scenario, Tables 8-5 and 8-6 for the Resident-B scenario, Tables 8-7 and 8-8 for the Farmer scenario, and Tables 8-9 and 8-10 for the Worker scenario. The parameters used in the calculations for adult soil/dust ingestion are presented in Appendix 8D.

8.2.2.4 Fish Consumption

Those who are most likely to be exposed to pollutants through fish consumption are local residents who use waters in the vicinity of the proposed SQI for recreational fishing. Engineers Lake, a recreational fishery about 8 km west of the facility, was selected for analysis because it was expected to have maximum surface water concentrations of pollutants. This was based on likely extended pollutant retention times as well as the impact of direct deposition and watershed area. Fish consumption was evaluated for the Resident-A, Resident-B, and Farmer scenarios.

A fish ingestion rate was derived from data taken from a fisherman survey and creel census taken at lakes, reservoirs, and rivers in the RMA area (northeast Colorado). An average fish consumption rate of 4.84 g/day was used for adults based on data for harvest rates of nontrout warm-water species and the amount of time anglers spend fishing (ESE et al., 1989).

The daily intakes of pollutants through fish consumption were estimated using the following formulas:

$$C_{Fish} = C_{Water} \times BCF$$

$$EDI_{Fish} = \frac{C_{fish} \times IR \times F}{BW}$$

Where:

C_{Fish} = The equilibrium concentration of the pollutant in fish from Engineers Lake (mg/kg)

C_{Water} = Surface water concentration in Engineers Lake (mg/L), see Appendix 7A

BCF = Bioconcentration factor (L/kg), Appendix 8E

EDI_{Fish} = Estimated daily intake due to fish ingestion (mg/kg/day)

IR	=	Ingestion rate, average daily fish consumption rate (4.84 g/day) (ESE et al., 1989)
F	=	Conversion factor (10^{-3} kg/g)
BW	=	Body weight, average adult (70 kg) (Ebasco, 1990)

Bioconcentration factors (BCFs) for the pollutants of concern, as well as all parameters used to calculate daily pollutant intakes from fish ingestion, are presented in Appendix 8E.

The estimated daily intake of organic contaminants due to fish ingestion was modified to account for the lipid content in the edible portion relative to that of the whole body of the fish. It was assumed that 10 percent of the fish lipid content would be found in the fillet. This modification was made only for organic compounds since they concentrate in areas of high lipid content.

The estimated daily intakes of pollutants through fish consumption are summarized in Tables 8-3 and 8-4 for the Resident-A scenario, Tables 8-5 and 8-6 for the Resident-B scenario, and Tables 8-7 and 8-8 for the Farmer scenario. Because individuals for all scenarios are assumed to fish in Engineers Lake, the estimated intakes are the same for all exposure scenarios.

8.2.3 Adult Dermal Exposure

This subsection estimates the potential pollutant intake due to dermal absorption from soils. For adults, dermal exposure is assumed to occur during outdoor activities such as farming, gardening activities, yard work, and maintenance work.

The following equation was used to calculate the dermal dose:

$$EDI_{Derm} = \frac{C_{Soil} \times AF \times SAF \times SMF \times ESA \times EF \times F}{BW}$$

Where:

EDI_{Derm}	=	Estimated daily intake due to dermal exposure to soil (mg pollutant/kg body weight/day)
C_{Soil}	=	Pollutant concentration in soil (mg/kg), Appendix 8A
AF	=	Absorption factor: • 10% - organics (Ebasco, 1990) • 1% - inorganics (Ebasco, 1990)
SAF	=	Skin adherence factor: • 0.51 mg/cm^2 - Resident-A and Resident-B scenarios (Ebasco, 1990) • 3.5 mg/cm^2 - Farmer and Worker scenarios (Ebasco, 1990)
SMF	=	Soil matrix factor (0.15) (Ebasco, 1990)
ESA	=	Exposed surface area (1,700 cm^2) (Ebasco, 1990)
EF	=	Exposure frequency, i.e., total number of exposures per year: • 117 days/year - Resident-A and Resident-B scenarios • 195 days/year - Farmer and Worker scenarios
F	=	Conversion factor: 10^{-6} kg/mg, year/365 days
BW	=	Body weight, average adult (70 kg) (Ebasco, 1990)

Dermal exposure was assumed to occur during the warmer two-thirds of the year (i.e., approximately 35 weeks per year). Both the farmer and maintenance worker, who tend to spend a greater than average time outside, were assumed to be dermally exposed 5 days per week. Residents were assumed to spend less time involved in outdoor activities, and so were evaluated based dermal exposure 3 times per week. Both the farmer and worker, therefore, were assumed to be exposed for 195 days per year, and the residents for 117 days per year. Both the farmer and the maintenance worker were assumed to have a 50-μm thick coating of dirt on their skin. The density of soil particles was assumed to be 1.5 g/cm^3. The

soil adhering to an individual's skin, therefore, would be 3.5 mg/cm^2. A lower soil adherence factor (0.51 mg/cm^2) was assumed for the residents based on a study of children in Hartford (Ebasco, 1990). The adult, for all scenarios, was assumed to have a coating of dirt on both hands and forearms, or 1,700 cm^2 of skin (Ebasco, 1990).

Absorption of contaminants from soil is inhibited by physical-chemical bonding to the matrix, in addition to the fact that only a small amount of the contaminant is in direct contact with the skin. To account for this effect, a soil matrix factor of 0.15 was used (Ebasco, 1990). Due to a lack of chemical-specific data, this matrix factor was used for all soil contaminants.

Dermal absorption factors of 10 percent for organic pollutants and 1 percent for inorganic pollutants were used. These values were selected to represent the differential absorption of organic and inorganic pollutants (Ebasco, 1990).

Predicted average concentrations for the pollutants of concern in the uppermost 10 cm of soil are listed for the exposure scenarios in Appendix 8A. These concentrations are based on the total deposition for each scenario location. The parameters that were used in the calculations for adult dermal exposure are given in Appendix 8F.

The estimated pollutant intakes resulting from dermal exposure due to soil contact are summarized in Tables 8-3 and 8-4 for the Resident-A scenario, Tables 8-5 and 8-6 for the Resident-B scenario, Tables 8-7 and 8-8 for the Farmer scenario, and Tables 8-9 and 8-10 for the Worker scenario.

Table 8-11 summarizes the exposure assumptions used for the adult in estimating total daily intakes. Exposure assumptions used for the child and the infant are also included in this table and are discussed in more detail in the following subsection.

8.3 ROUTES OF EXPOSURE CONSIDERED FOR CHILDREN AND INFANTS

Children and infants were evaluated in the Resident-A, Resident-B, and Farmer exposure scenarios. Children were assumed to be exposed to pollutants through the pathways of exposure applicable to adults (Subsection 8.2). Infants were assumed to be exposed to pollutants only by the ingestion of mother's milk and the inhalation pathway.

Childhood exposure in this assessment was assumed to occur in children 1 to 6 years old. The average weight of a child between 1 and 6 years old was estimated to be 15.5 kg (Ebasco, 1990). The average weight of an infant age 0 to 1 was estimated to be 9 kg (EPA, 1989b). Other infant and childhood factors specific to individual routes of exposure are presented in the subsections that follow. All exposure doses calculated for children and infants, based on the Resident-A, Resident-B, and Farmer scenarios, are presented at the end of Subsection 8.3. All of the exposure assumptions are presented in Table 8-11.

8.3.1 Children and Infant Inhalation Exposure

Childhood and infant inhalation exposure was calculated using the methodology described for adult inhalation (Subsection 8.2.1). It was assumed that childhood inhalation exposure was continuous for the 2-year lifetime of the facility, and infant exposure was continuous for 1 year. The average inhalation rate for children, 1 to 6 years old, was estimated to be 10 m^3/day (NRC, 1977), and the average inhalation rate for infants, 0 to 1 year, was estimated to be 3.8 m^3/day (NCRP, 1984). Predicted ambient air concentrations for the three exposure scenarios (Resident-A, Resident-B, and Farmer) are presented in Table 8-2. The estimated childhood intakes due to inhalation are presented in Tables 8-12 and 8-13 for the Resident-A scenario, Tables 8-14 and 8-15 for the Resident-B scenario, and Tables 8-16 and 8-17 for the Farmer scenario. The estimated infant intakes due to inhalation are presented in Table 8-18 for the Resident-A scenario, Table 8-19 for the Resident-B scenario, and Table 8-20 for the Farmer scenario.

8.3.2 Children Ingestion Exposure

8.3.2.1 Vegetable, Milk, Beef, Soil/Dust, and Fish Consumption

Childhood ingestion exposure was calculated using the same methodology described for the adult (Subsection 8.2.2). Food and soil/dust ingestion rates specific to children 1 to 6 years old are presented in Table 8-11. It should be noted that soil/dust ingestion rates for young children are higher than those for older children and adults. Soil/dust ingestion in young children can occur indirectly by placing dirt-covered hands or objects in the mouth, or in some cases, by directly eating soil. The soil concentrations used in the exposure calculations are presented in Appendix 8A.

Total average and maximum daily intakes for children for all ingestion routes of exposure are summarized at the end of Section 8 in Tables 8-12 and 8-13 for the Resident-A scenario, Tables 8-14 and 8-15 for the Resident-B scenario, and Tables 8-16 and 8-17 for the Farmer scenario. The parameters used in the calculations for child vegetable consumption, milk and beef consumption, soil/dust consumption, and fish consumption are presented in Appendices 8B, 8C, 8D, and 8E, respectively.

8.3.3 Children Dermal Absorption

This subsection estimates the potential childhood pollutant intake due to the dermal absorption of pollutants from soils. The methodology used to calculate the dermal intake of pollutants in children was the same as that described for adults in Subsection 8.2.3. Only the specific input parameters used to calculate doses for children are discussed in the following paragraphs.

As with the adult, it was assumed that dermal exposure would occur during the warmer two-thirds of the year, or approximately 35 weeks per year. Also, it was assumed that children, on the average, would spend 5 days per week outside, resulting in a total of 195 dermal exposure events per year. A soil adherence factor of 0.51 mg/cm^2 was used based on a study of children in Hartford (Ebasco, 1990). The area of exposed skin averaged for 1

through 6 year-olds was estimated to be 2,188 cm^2 based on exposed surface area of arms, hands, and legs for 50 percent of the time, and arms and hands for the other 50 percent (EPA, 1989b). This represents an average exposed surface area for the exposure period.

The concentrations of pollutants in the uppermost 10 cm of soil were previously calculated (Appendix 8A). The estimated dosages of pollutants to children through dermal exposure are summarized at the end of Section 8 in Tables 8-12 and 8-13 for the Resident-A scenario, Tables 8-14 and 8-15 for the Resident-B scenario, and Tables 8-16 and 8-17 for the Farmer scenario. The parameters used in the calculations for child dermal exposure are presented in Appendix 8F.

8.3.4 Infant Consumption of Mother's Milk

The intake of pollutants by infants through breast milk consumption was addressed for the organic pollutants of concern. There were insufficient data available in the surveyed literature to quantify the potential transfer of inorganic pollutants into human breast milk.

The estimated daily intakes of organic pollutants through breast milk ingestion were determined using the following equation:

$$EDI = \frac{C_{Bmilk} \times BMIR}{BW}$$

Where:

EDI = Estimated daily intake resulting from the ingestion of breast milk (mg/kg/day)

C_{Bmilk} = Concentration of the pollutant in breast milk (mg/kg), Appendix 8G

$BMIR$ = Breast milk ingestion rate (0.8 kg/day) (Smith, 1987)

BW = Body weight, infant 0 to 1 year (9 kg) (EPA, 1989b)

Factors used in the calculation of pollutant concentrations in breast milk are more fully discussed in Appendix 8G. An infant was assumed to ingest 0.8 kg/day of breast milk (Smith, 1987), and to breast feed for 1 year. A body weight of 9 kg, the average body weight of children less than 1 year of age, was used (EPA, 1989b).

The maximum estimated daily intakes of pollutants for infants through breast milk ingestion exposure are summarized in Table 8-18 for the Resident-A scenario, Table 8-19 for the Resident-B scenario, and Table 8-20 for the Farmer scenario. Average daily intakes were not calculated for the infant; maximum daily intakes were used in calculation of both carcinogenic risk and noncarcinogenic health effects for the infant.

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Table 8-2

Predicted Ambient Air Concentrations

Pollutant	Predicted Average Annual Concentration ($\mu g/m^3$)			
	Resident-A	Resident-B	Farmer	Worker
ORGANICS				
Acetone	1.76E-13	2.76E-14	6.19E-14	5.19E-14
Acetonitrile	1.07E-11	1.68E-12	3.76E-12	3.15E-12
Acrylonitrile	1.07E-12	1.68E-13	3.76E-13	3.15E-13
Aldrin	1.14E-13	1.78E-14	3.98E-14	3.34E-14
Atrazine	2.52E-14	3.95E-15	8.85E-15	7.41E-15
Benzaldehyde	2.33E-09	3.64E-10	8.16E-10	6.83E-10
Benzene	2.29E-09	3.59E-10	8.05E-10	6.74E-10
Benzofuran	4.46E-09	6.99E-10	1.57E-09	1.31E-09
Benzoic Acid	1.13E-09	1.76E-10	3.95E-10	3.31E-10
Benzonitrile	1.07E-12	1.68E-13	3.76E-13	3.15E-13
Biphenyl	1.12E-09	1.75E-10	3.92E-10	3.28E-10
Bromomethane	2.23E-10	3.50E-11	7.84E-11	6.57E-11
Carbazole	2.14E-13	3.36E-14	7.52E-14	6.30E-14
Carbon Tetrachloride	7.11E-13	1.11E-13	2.50E-13	2.09E-13
Chlorobenzene	5.52E-10	8.64E-11	1.94E-10	1.62E-10
4-Chlorobiphenyl	1.30E-09	2.03E-10	4.54E-10	3.81E-10
4,4-Chlorobiphenyl	1.70E-11	2.66E-12	5.95E-12	4.98E-12
Chloroform	1.13E-13	1.76E-14	3.95E-14	3.31E-14
4-Chlorophenylmethylsulfone	4.14E-13	6.48E-14	1.45E-13	1.22E-13
4-Chlorophenylmethylsulfoxide	1.54E-12	2.41E-13	5.41E-13	4.53E-13
p,p-DDE	1.89E-10	2.96E-11	6.62E-11	5.55E-11
p,p-DDT	3.78E-14	5.92E-15	1.33E-14	1.11E-14
Dibenzofuran	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Dichlorobenzenes (total)	4.02E-13	6.29E-14	1.41E-13	1.18E-13
1,4-Dichlorobenzene	2.54E-14	3.98E-15	8.91E-15	7.46E-15
1,1-Dichloroethene	6.25E-13	9.78E-14	2.19E-13	1.84E-13
1,2-Dichloroethene	4.35E-13	6.80E-14	1.52E-13	1.28E-13
1,2-Dichloropropane	5.06E-14	7.93E-15	1.78E-14	1.49E-14
Dieldrin	2.33E-14	3.65E-15	8.18E-15	6.85E-15
Diisopropyl Methylphosphonate	4.09E-12	6.41E-13	1.44E-12	1.20E-12
1,3-Dimethylbenzene	4.46E-10	6.99E-11	1.57E-10	1.31E-10
Dimethyldisulfide	1.14E-11	1.78E-12	3.98E-12	3.34E-12
Dimethyl Methylphosphonate	9.76E-11	1.53E-11	3.42E-11	2.87E-11
Dimethylphosphate	2.68E-11	4.19E-12	9.39E-12	7.87E-12
Dioxins/Furans (EPA TEFs)	6.84E-11	1.07E-11	2.40E-11	2.01E-11
Dithiane	4.09E-15	6.41E-16	1.44E-15	1.20E-15
Endrin	2.27E-14	3.55E-15	7.95E-15	6.66E-15
Ethylbenzene	6.70E-10	1.05E-10	2.35E-10	1.97E-10
Hexachlorobenzene	7.62E-12	1.19E-12	2.67E-12	2.24E-12
Hexachlorocyclopentadiene	2.11E-13	3.31E-14	7.41E-14	6.20E-14
Isodrin	5.97E-14	9.35E-15	2.10E-14	1.76E-14
Malathion	9.12E-14	1.43E-14	3.20E-14	2.68E-14
Methanol	2.59E-09	4.06E-10	9.09E-10	7.61E-10
Methyl Chloride	2.23E-09	3.50E-10	7.84E-10	6.57E-10
Methylene Chloride	2.23E-10	3.50E-11	7.84E-11	6.57E-11
4-Nitrophenol	9.44E-13	1.48E-13	3.31E-13	2.77E-13
PAHs				
Acenaphthalene	1.12E-09	1.75E-10	3.92E-10	3.28E-10
Acenaphthene	1.12E-09	1.75E-10	3.92E-10	3.28E-10
Benzo(a)pyrene	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Chrysene	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Dibenzo(a,h)anthracene	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Fluoranthene	6.70E-10	1.05E-10	2.35E-10	1.97E-10
Fluorene	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Phenanthrene	4.46E-10	6.99E-11	1.57E-10	1.31E-10
Pyrene	2.23E-10	3.49E-11	7.82E-11	6.55E-11
Parathion	1.26E-14	1.97E-15	4.42E-15	3.70E-15
Pentachlorobenzene	3.41E-12	5.33E-13	1.20E-12	1.00E-12
Phenol	1.21E-08	1.89E-09	4.24E-09	3.55E-09
Pyridine	1.07E-13	1.68E-14	3.76E-14	3.15E-14
Quinoline	5.34E-13	8.35E-14	1.87E-13	1.57E-13
Styrene	2.24E-09	3.51E-10	7.86E-10	6.58E-10

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Table 8-2
(continued)

Supona	3.78E-14	5.92E-15	1.33E-14	1.11E-14
Tetrachlorobenzene	1.44E-12	2.25E-13	5.04E-13	4.22E-13
Tetrachloroethene	8.89E-12	1.39E-12	3.12E-12	2.61E-12
Toluene	1.12E-09	1.75E-10	3.92E-10	3.28E-10
Trichlorobenzene	7.57E-13	1.19E-13	2.66E-13	2.22E-13
Trichloroethene	1.37E-12	2.14E-13	4.80E-13	4.02E-13
Urea	1.64E-08	2.56E-09	5.74E-09	4.81E-09
Vapona	1.01E-13	1.58E-14	3.54E-14	2.96E-14
Vinyl Chloride	2.23E-09	3.50E-10	7.84E-10	6.57E-10
Xylene	4.46E-10	6.99E-11	1.57E-10	1.31E-10
INORGANICS				
Aluminum	2.96E-04	4.63E-05	1.04E-04	8.70E-05
Ammonia	5.34E-05	8.35E-06	1.87E-05	1.57E-05
Antimony	1.04E-05	1.63E-06	3.65E-06	3.06E-06
Arsenic	5.88E-05	9.21E-06	2.06E-05	1.73E-05
Barium	1.44E-05	2.26E-06	5.06E-06	4.23E-06
Beryllium	6.02E-07	9.42E-08	2.11E-07	1.77E-07
Boron	4.39E-04	6.88E-05	1.54E-04	1.29E-04
Cadmium	1.71E-06	2.68E-07	6.02E-07	5.04E-07
Calcium	2.52E-03	3.95E-04	8.85E-04	7.41E-04
Chromium (III)	3.91E-06	6.12E-07	1.37E-06	1.15E-06
Chromium (VI)	1.38E-07	2.16E-08	4.83E-08	4.05E-08
Cobalt	1.30E-05	2.03E-06	4.54E-06	3.81E-06
Copper	5.52E-02	8.64E-03	1.94E-02	1.62E-02
Cyanogen	1.07E-13	1.68E-14	3.76E-14	3.15E-14
Hydrogen Cyanide	1.06E-09	1.66E-10	3.71E-10	3.11E-10
Iron	7.84E-04	1.23E-04	2.75E-04	2.30E-04
Lead	1.85E-05	2.89E-06	6.48E-06	5.43E-06
Lithium	1.81E-06	2.83E-07	6.34E-07	5.31E-07
Magnesium	2.34E-03	3.67E-04	8.22E-04	6.89E-04
Manganese	1.01E-04	1.59E-05	3.55E-05	2.97E-05
Mercury	1.63E-05	2.55E-06	5.71E-06	4.78E-06
Molybdenum	1.81E-04	2.83E-05	6.35E-05	5.32E-05
Nickel	4.70E-04	7.35E-05	1.65E-04	1.38E-04
Phosphate	5.47E-02	8.57E-03	1.92E-02	1.61E-02
Potassium	1.87E-02	2.92E-03	6.54E-03	5.48E-03
Selenium	1.51E-01	2.36E-02	5.30E-02	4.44E-02
Silicon	2.60E-03	4.07E-04	9.12E-04	7.64E-04
Silver	1.56E-03	2.45E-04	5.49E-04	4.60E-04
Sodium	1.92E+00	3.01E-01	6.74E-01	5.64E-01
Strontium	6.02E-07	9.42E-08	2.11E-07	1.77E-07
Thallium	1.52E-04	2.38E-05	5.33E-05	4.46E-05
Tin	1.33E-04	2.08E-05	4.66E-05	3.90E-05
Titanium	1.00E-06	1.57E-07	3.52E-07	2.95E-07
Vanadium	3.84E-05	6.01E-06	1.35E-05	1.13E-05
Yittrium	3.51E-07	5.50E-08	1.23E-07	1.03E-07
Zinc	2.67E-04	4.18E-05	9.38E-05	7.85E-05
CRITERIA POLLUTANTS/ ACID GASES				
Carbon Monoxide	7.75E-02	1.21E-02	2.72E-02	2.28E-02
Hydrogen Chloride	7.75E-02	1.21E-02	2.72E-02	2.28E-02
Hydrogen Fluorides	2.74E-03	4.28E-04	9.60E-04	8.04E-04
Nitric Acid	6.38E-02	1.00E-02	2.24E-02	1.88E-02
Nitrogen Dioxide	5.29E-01	8.28E-02	1.86E-01	1.55E-01
Particulate Matter	2.28E-01	3.57E-02	8.00E-02	6.70E-02
Sulfur Dioxide	4.01E-01	6.28E-02	1.41E-01	1.18E-01
Sulfuric Acid Mist	1.69E-01	2.64E-02	5.92E-02	4.96E-02

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Table 8-3

Average Total Pollutant Daily Intake for the Adult, Resident-A Scenario

Pollutant	Daily Intake (mg/kg/day)							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	5.04E-17	NA	NA	NA	NA	NA	NA	5.04E-17
Acetonitrile	3.06E-15	2.76E-15	4.89E-22	1.92E-22	1.63E-18	8.42E-22	3.39E-20	5.82E-15
Acrylonitrile	3.06E-16	NA	NA	NA	NA	NA	NA	3.06E-16
Aldrin	3.24E-17	6.48E-18	8.33E-20	1.19E-20	1.72E-20	2.08E-22	3.59E-22	3.90E-17
Atrazine	7.20E-18	7.20E-21	5.35E-25	1.22E-25	3.98E-23	0.00E+00	8.29E-25	7.21E-18
Benzaldehyde	6.64E-13	3.18E-14	6.18E-19	2.42E-19	3.53E-16	2.31E-17	7.35E-18	6.97E-13
Benzene	6.55E-13	NA	NA	NA	NA	NA	NA	6.55E-13
Benzofuran	1.28E-12	3.25E-14	3.79E-18	1.47E-18	6.77E-16	1.99E-16	1.41E-17	1.31E-12
Benzoic Acid	3.22E-13	9.99E-15	4.37E-19	1.71E-19	1.71E-16	2.01E-17	3.56E-18	3.32E-13
Benzonitrile	3.06E-16	1.34E-17	3.08E-22	1.20E-22	1.63E-19	1.18E-20	3.39E-21	3.20E-16
Biphenyl	3.19E-13	NA	NA	NA	NA	NA	NA	3.19E-13
Bromomethane	6.38E-14	NA	NA	NA	NA	NA	NA	6.38E-14
Carbazole	6.12E-17	9.71E-19	3.38E-22	1.29E-22	3.25E-20	1.27E-20	6.78E-22	6.23E-17
Carbon Tetrachloride	2.03E-16	NA	NA	NA	NA	NA	NA	2.03E-16
Chlorobenzene	1.58E-13	NA	NA	NA	NA	NA	NA	1.58E-13
4-Chlorobiphenyl	3.70E-13	2.61E-15	1.20E-17	3.98E-18	1.96E-16	5.60E-17	4.09E-18	3.73E-13
4,4-Chlorobiphenyl	4.85E-15	2.64E-17	4.05E-19	1.12E-19	2.57E-18	2.45E-19	5.36E-20	4.88E-15
Chloroform	3.22E-17	NA	NA	NA	NA	NA	NA	3.22E-17
4-Chlorophenylmethylsulfone	1.18E-16	2.46E-19	1.91E-24	7.02E-25	1.31E-21	2.95E-21	2.73E-23	1.19E-16
4-Chlorophenylmethylsulfoxide	4.40E-16	8.64E-19	8.21E-24	2.98E-24	4.87E-21	1.09E-20	1.01E-22	4.41E-16
p,p-DDE	5.39E-14	4.36E-17	2.95E-18	4.84E-19	5.34E-18	6.36E-16	1.11E-19	5.46E-14
p,p-DDT	1.08E-17	3.32E-20	2.46E-21	3.34E-22	1.07E-21	1.33E-19	2.23E-23	1.10E-17
Dibenzofuran	6.37E-14	6.33E-16	8.36E-19	3.06E-19	3.38E-17	1.97E-17	7.05E-19	6.44E-14
Dichlorobenzenes (total)	1.15E-16	NA	NA	NA	NA	NA	NA	1.15E-16
1,4-Dichlorobenzene	7.25E-18	NA	NA	NA	NA	NA	NA	7.25E-18
1,1-Dichloroethene	1.78E-16	NA	NA	NA	NA	NA	NA	1.78E-16
1,2-Dichloroethene	1.24E-16	NA	NA	NA	NA	NA	NA	1.24E-16
1,2-Dichloropropane	1.45E-17	NA	NA	NA	NA	NA	NA	1.45E-17
Dieldrin	6.66E-18	8.93E-18	1.55E-21	3.40E-22	3.53E-21	8.91E-21	7.37E-23	1.56E-17
Diisopropyl Methylphosphonate	1.17E-15	2.59E-18	6.33E-23	2.32E-23	2.59E-20	5.61E-20	5.39E-22	1.17E-15
1,3-Dimethylbenzene	1.28E-13	2.15E-15	6.43E-19	2.47E-19	6.77E-17	2.58E-17	1.41E-18	1.30E-13
Dimethyldisulfide	3.24E-15	NA	NA	NA	NA	NA	NA	3.24E-15
Dimethyl Methylphosphonate	2.79E-14	9.23E-17	7.25E-25	2.75E-25	1.02E-20	3.07E-19	2.13E-22	2.80E-14
Dimethylphosphate	7.65E-15	5.70E-18	NE	NE	4.06E-18	NE	8.46E-20	7.66E-15
Dioxins/Furans (EPA TEFs)	1.95E-14	1.77E-17	2.06E-18	1.10E-18	2.55E-18	2.24E-17	5.31E-20	1.96E-14
Dithiane	1.17E-18	1.34E-19	5.47E-25	2.14E-25	6.21E-22	1.49E-23	1.29E-23	1.31E-18
Endrin	6.48E-18	5.66E-21	4.58E-23	1.20E-23	7.10E-22	1.26E-21	1.48E-23	6.48E-18
Ethylbenzene	1.92E-13	NA	NA	NA	NA	NA	NA	1.92E-13
Hexachlorobenzene	2.18E-15	5.07E-18	7.03E-20	1.12E-20	1.44E-19	4.41E-18	3.01E-21	2.19E-15
Hexachlorocyclopentadiene	6.03E-17	8.49E-18	4.53E-21	1.28E-21	3.20E-20	6.95E-21	6.68E-22	6.89E-17
Isodrin	1.71E-17	1.16E-17	7.07E-21	1.37E-21	9.06E-21	2.04E-19	1.89E-22	2.89E-17
Malathion	2.61E-17	2.74E-19	9.63E-23	3.73E-23	1.38E-20	0.00E+00	2.88E-22	2.63E-17

Table 8-3
(continued)

Methanol	7.40E-13	6.80E-13	7.42E-20	2.91E-20	3.93E-16	9.50E-18	8.19E-18	1.42E-12
Methyl Chloride	6.38E-13	NA	NA	NA	NA	NA	NA	6.38E-13
Methylene Chloride	6.38E-14	NA	NA	NA	NA	NA	NA	6.38E-14
4-Nitrophenol	2.70E-16	5.62E-18	1.02E-21	3.93E-22	1.43E-19	4.89E-20	2.98E-21	2.76E-16
PAHs								
Acenaphthalene	3.19E-13	7.40E-15	3.97E-18	1.46E-18	1.69E-16	9.49E-17	3.53E-18	3.27E-13
Acenaphthene	3.19E-13	3.54E-15	3.38E-18	1.26E-18	1.69E-16	3.68E-17	3.53E-18	3.23E-13
Benzo(a)pyrene	6.37E-14	4.82E-17	1.54E-17	1.76E-18	5.96E-19	1.26E-17	1.24E-20	6.38E-14
Chrysene	6.37E-14	5.54E-17	3.66E-18	4.33E-19	7.47E-19	3.19E-16	1.56E-20	6.41E-14
Dibenzo(a,h)anthracene	6.37E-14	4.93E-17	1.85E-17	2.12E-18	8.11E-19	7.16E-15	1.69E-20	7.09E-14
Fluoranthene	1.92E-13	1.87E-16	3.03E-18	3.80E-19	2.19E-18	NA	4.56E-20	1.92E-13
Fluorene	6.37E-14	8.94E-16	1.12E-18	3.98E-19	3.38E-17	2.64E-17	7.05E-19	6.47E-14
Phenanthrene	1.28E-13	1.14E-16	4.67E-19	6.24E-20	1.03E-18	8.86E-17	2.16E-20	1.28E-13
Pyrene	6.37E-14	5.70E-17	9.08E-19	1.11E-19	5.01E-19	7.27E-17	1.05E-20	6.38E-14
Parathion	3.60E-18	4.19E-20	3.39E-23	1.27E-23	1.91E-21	6.54E-22	3.98E-23	3.64E-18
Pentachlorobenzene	9.73E-16	2.45E-17	4.00E-20	1.27E-20	5.17E-19	NA	1.08E-20	9.98E-16
Phenol	3.45E-12	5.15E-13	3.15E-18	1.23E-18	1.83E-15	2.10E-17	3.82E-17	3.97E-12
Pyridine	3.06E-17	NA	NA	NA	NA	NA	NA	3.06E-17
Quinoline	1.52E-16	7.52E-18	2.42E-22	9.46E-23	8.09E-20	1.22E-20	1.69E-21	1.60E-16
Styrene	6.40E-13	NA	NA	NA	NA	NA	NA	6.40E-13
Supona	1.08E-17	1.50E-19	4.97E-23	1.91E-23	5.73E-21	2.13E-21	1.20E-22	1.10E-17
Tetrachlorobenzene	4.10E-16	2.37E-17	7.10E-21	2.54E-21	2.18E-19	NA	4.54E-21	4.34E-16
Tetrachloroethene	2.54E-15	NA	NA	NA	NA	NA	NA	2.54E-15
Toluene	3.19E-13	NA	NA	NA	NA	NA	NA	3.19E-13
Trichlorobenzene	2.16E-16	1.51E-18	2.44E-21	9.04E-22	1.15E-19	9.56E-20	2.39E-21	2.18E-16
Trichloroethene	3.91E-16	NA	NA	NA	NA	NA	NA	3.91E-16
Urea	4.68E-12	7.40E-11	5.87E-20	2.30E-20	2.48E-15	6.01E-17	5.18E-17	7.87E-11
Vapona	2.88E-17	1.51E-18	2.48E-23	9.70E-24	1.53E-20	8.82E-22	3.19E-22	3.03E-17
Vinyl Chloride	6.38E-13	NA	NA	NA	NA	NA	NA	6.38E-13
Xylene	1.28E-13	NA	NA	NA	NA	NA	NA	1.28E-13
INORGANICS								
Aluminum	8.46E-08	NA	NA	NA	NA	NE	NA	8.46E-08
Ammonia	1.52E-08	NA	NA	NA	NA	NA	NA	1.52E-08
Antimony	2.97E-09	3.48E-12	8.40E-15	8.71E-15	1.58E-12	NA	3.29E-15	2.98E-09
Arsenic	1.68E-08	1.39E-11	7.18E-12	9.39E-14	8.92E-12	1.49E-11	1.86E-14	1.69E-08
Barium	4.12E-09	4.13E-12	5.98E-14	1.52E-15	2.19E-12	NE	4.56E-15	4.12E-09
Beryllium	1.72E-10	1.32E-13	2.07E-18	9.99E-17	9.13E-14	7.67E-15	1.90E-16	1.72E-10
Boron	1.25E-07	NA	NA	NA	NA	NE	NA	1.25E-07
Cadmium	4.90E-10	NA	NA	NA	NA	3.78E-13	NA	4.90E-10
Calcium	7.20E-07	NA	NA	NA	NA	NA	NA	7.20E-07
Chromium (III)	1.12E-09	NA	NA	NA	NA	NA	NA	1.12E-09
Chromium (VI)	3.93E-11	NA	NA	NA	NA	1.43E-14	NA	3.94E-11
Cobalt	3.70E-09	NA	NA	NA	NA	1.74E-13	NA	3.70E-09
Copper	1.58E-05	4.93E-08	3.86E-09	2.64E-09	8.37E-09	4.48E-08	1.74E-11	1.59E-05
Cyanogen	3.06E-17	NA	NA	NA	NA	NA	NA	3.06E-17
Hydrogen Cyanide	3.02E-13	NA	NA	NA	NA	NA	NA	3.02E-13
Iron	2.24E-07	NA	NA	NA	NA	NE	NA	2.24E-07
Lead	5.28E-09	4.53E-12	5.22E-14	4.75E-15	2.80E-12	2.28E-12	5.84E-15	5.29E-09
Lithium	5.16E-10	NA	NA	NA	NA	NE	NA	5.16E-10
Magnesium	6.70E-07	NA	NA	NA	NA	NE	NA	6.70E-07

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Table 8-3
(continued)

Manganese	2.89E-08	NA	NA	NA	NA	NA	NA	2.89E-08
Mercury	4.65E-09	1.48E-11	2.75E-13	2.03E-11	2.47E-12	NA	5.15E-15	4.69E-09
Molybdenum	5.17E-08	NA	NA	NA	NA	NE	NA	5.17E-08
Nickel	1.34E-07	NA	NA	NA	NA	NA	NA	1.34E-07
Phosphate	1.56E-05	NA	NA	NA	NA	NA	NA	1.56E-05
Potassium	5.33E-06	NA	NA	NA	NA	NA	NA	5.33E-06
Selenium	4.31E-05	4.18E-08	1.32E-08	2.82E-09	2.29E-08	1.75E-09	4.77E-11	4.32E-05
Silicon	7.43E-07	NA	NA	NA	NA	NA	NA	7.43E-07
Silver	4.47E-07	8.57E-10	1.09E-09	1.45E-11	2.37E-10	3.46E-09	4.95E-13	4.53E-07
Sodium	5.49E-04	NA	NA	NA	NA	NA	NA	5.49E-04
Strontium	1.72E-10	NA	NA	NA	NA	NE	NA	1.72E-10
Thallium	4.34E-08	3.26E-11	1.04E-12	7.97E-13	2.30E-11	NA	4.80E-14	4.34E-08
Tin	3.79E-08	NA	NA	NA	NA	NE	NA	3.79E-08
Titanium	2.87E-10	NA	NA	NA	NA	NE	NA	2.87E-10
Vanadium	1.10E-08	NA	NA	NA	NA	2.58E-13	NA	1.10E-08
Yittrium	1.00E-10	NA	NA	NA	NA	NE	NA	1.00E-10
Zinc	7.63E-08	NA	NA	NA	NA	1.06E-10	NA	7.65E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	2.21E-05	NA	NA	NA	NA	NA	NA	2.21E-05
Hydrogen Chloride	2.21E-05	NA	NA	NA	NA	NA	NA	2.21E-05
Hydrogen Fluorides	7.82E-07	NA	NA	NA	NA	NA	NA	7.82E-07
Nitric Acid	1.82E-05	NA	NA	NA	NA	NA	NA	1.82E-05
Nitrogen Dioxide	1.51E-04	NA	NA	NA	NA	NA	NA	1.51E-04
Particulate Matter	6.51E-05	NA	NA	NA	NA	NA	NA	6.51E-05
Sulfur Dioxide	1.15E-04	NA	NA	NA	NA	NA	NA	1.15E-04
Sulfuric Acid Mist	4.82E-05	NA	NA	NA	NA	NA	NA	4.82E-05

NA = Not applicable
NE = Not evaluated

DRAFT

Table 8-4

Maximum Total Pollutant Daily Intake for the Adult, Resident-A Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	5.04E-17	NA	NA	NA	NA	NA	NA	5.04E-17
Acetonitrile	3.06E-15	2.88E-15	5.00E-22	1.95E-22	1.65E-18	8.42E-22	3.44E-20	5.94E-15
Acrylonitrile	3.06E-16	NA	NA	NA	NA	NA	NA	3.06E-16
Aldrin	3.24E-17	7.40E-18	2.60E-18	2.94E-19	1.75E-20	2.08E-22	3.64E-22	4.28E-17
Atrazine	7.20E-18	2.48E-19	1.82E-23	4.08E-24	1.31E-21	0.00E+00	2.72E-23	7.45E-18
Benzaldehyde	6.64E-13	4.91E-14	6.89E-19	2.52E-19	3.58E-16	2.31E-17	7.46E-18	7.14E-13
Benzene	6.55E-13	NA	NA	NA	NA	NA	NA	6.55E-13
Benzofuran	1.28E-12	6.53E-14	5.69E-18	1.70E-18	6.87E-16	1.99E-16	1.43E-17	1.34E-12
Benzoic Acid	3.22E-13	1.83E-14	5.17E-19	1.82E-19	1.73E-16	2.01E-17	3.61E-18	3.40E-13
Benzonitrile	3.06E-16	2.13E-17	3.47E-22	1.26E-22	1.65E-19	1.18E-20	3.44E-21	3.28E-16
Biphenyl	3.19E-13	NA	NA	NA	NA	NA	NA	3.19E-13
Bromomethane	6.38E-14	NA	NA	NA	NA	NA	NA	6.38E-14
Carbazole	6.12E-17	2.54E-18	7.12E-22	1.73E-22	3.30E-20	1.27E-20	6.87E-22	6.38E-17
Carbon Tetrachloride	2.03E-16	NA	NA	NA	NA	NA	NA	2.03E-16
Chlorobenzene	1.58E-13	NA	NA	NA	NA	NA	NA	1.58E-13
4-Chlorobiphenyl	3.70E-13	1.20E-14	1.03E-16	1.42E-17	1.99E-16	5.60E-17	4.15E-18	3.82E-13
4,4-Chlorobiphenyl	4.85E-15	1.49E-16	6.10E-18	7.51E-19	2.61E-18	2.45E-19	5.44E-20	5.01E-15
Chloroform	3.22E-17	NA	NA	NA	NA	NA	NA	3.22E-17
4-Chlorophenylmethylsulfone	1.18E-16	7.24E-18	5.17E-23	1.86E-23	3.43E-20	2.95E-21	7.15E-22	1.26E-16
4-Chlorophenylmethylsulfoxide	4.40E-16	2.55E-17	2.23E-22	7.91E-23	1.28E-19	1.09E-20	2.66E-21	4.66E-16
p,p-DDE	5.39E-14	1.42E-15	8.68E-17	1.05E-17	2.68E-17	6.36E-16	5.59E-19	5.61E-14
p,p-DDT	1.08E-17	4.08E-19	7.98E-20	9.24E-21	5.37E-21	1.33E-19	1.12E-22	1.14E-17
Dibenzofuran	6.37E-14	2.25E-15	3.44E-18	6.02E-19	3.43E-17	1.97E-17	7.15E-19	6.60E-14
Dichlorobenzenes (total)	1.15E-16	NA	NA	NA	NA	NA	NA	1.15E-16
1,4-Dichlorobenzene	7.25E-18	NA	NA	NA	NA	NA	NA	7.25E-18
1,1-Dichloroethene	1.78E-16	NA	NA	NA	NA	NA	NA	1.78E-16
1,2-Dichloroethene	1.24E-16	NA	NA	NA	NA	NA	NA	1.24E-16
1,2-Dichloropropane	1.45E-17	NA	NA	NA	NA	NA	NA	1.45E-17
Dieldrin	6.66E-18	9.22E-18	3.42E-20	4.00E-21	3.59E-21	8.91E-21	7.47E-23	1.59E-17
Diisopropyl Methylphosphonate	1.17E-15	6.06E-17	1.21E-21	4.17E-22	4.53E-19	5.61E-20	9.44E-21	1.23E-15
1,3-Dimethylbenzene	1.28E-13	5.41E-15	1.28E-18	3.20E-19	6.87E-17	2.58E-17	1.43E-18	1.33E-13
Dimethyldisulfide	3.24E-15	NA	NA	NA	NA	NA	NA	3.24E-15
Dimethyl Methylphosphonate	2.79E-14	3.23E-15	2.54E-23	9.62E-24	3.57E-19	3.07E-19	7.44E-21	3.11E-14
Dimethylphosphate	7.65E-15	1.99E-16	NE	NE	4.12E-18	NE	8.59E-20	7.85E-15
Dioxins/Furans (EPA TEFs)	1.95E-14	5.22E-16	6.26E-17	2.56E-17	9.91E-18	2.24E-17	2.06E-19	2.02E-14
Dithiane	1.17E-18	1.66E-19	5.76E-25	2.20E-25	6.30E-22	1.49E-23	1.31E-23	1.34E-18
Endrin	6.48E-18	1.73E-19	8.60E-22	1.28E-22	3.25E-21	1.26E-21	6.77E-23	6.65E-18
Ethylbenzene	1.92E-13	NA	NA	NA	NA	NA	NA	1.92E-13
Hexachlorobenzene	2.18E-15	8.16E-17	2.13E-18	2.63E-19	1.04E-18	4.41E-18	2.17E-20	2.27E-15
Hexachlorocyclopentadiene	6.03E-17	1.01E-17	6.49E-20	8.06E-21	3.25E-20	6.95E-21	6.77E-22	7.06E-17
Isodrin	1.71E-17	1.22E-17	1.78E-19	2.05E-20	9.19E-21	2.04E-19	1.92E-22	2.97E-17
Malathion	2.61E-17	9.37E-19	1.60E-22	4.48E-23	1.40E-20	0.00E+00	2.93E-22	2.70E-17

Table 8-4
(continued)

Methanol	7.40E-13	7.08E-13	7.57E-20	2.96E-20	3.99E-16	9.50E-18	8.31E-18	1.45E-12
Methyl Chloride	6.38E-13	NA	NA	NA	NA	NA	NA	6.38E-13
Methylene Chloride	6.38E-14	NA	NA	NA	NA	NA	NA	6.38E-14
4-Nitrophenol	2.70E-16	1.25E-17	1.71E-21	4.75E-22	1.45E-19	4.89E-20	3.03E-21	2.82E-16
PAHs								
Acenaphthalene	3.19E-13	1.56E-14	1.56E-17	2.78E-18	1.72E-16	9.49E-17	3.58E-18	3.35E-13
Acenaphthene	3.19E-13	1.17E-14	1.16E-17	2.19E-18	1.72E-16	3.68E-17	3.58E-18	3.31E-13
Benzo(a)pyrene	6.37E-14	1.68E-15	5.37E-16	6.11E-17	1.68E-17	1.26E-17	3.50E-19	6.60E-14
Chrysene	6.37E-14	1.86E-15	1.27E-16	1.49E-17	1.91E-17	3.19E-16	3.97E-19	6.61E-14
Dibenzo(a,h)anthracene	6.37E-14	1.71E-15	6.46E-16	7.36E-17	1.99E-17	7.16E-15	4.14E-19	7.33E-14
Fluoranthene	1.92E-13	6.14E-15	1.05E-16	1.28E-17	5.65E-17	NA	1.18E-18	1.98E-13
Fluorene	6.37E-14	2.52E-15	5.85E-18	9.33E-19	3.43E-17	2.64E-17	7.15E-19	6.63E-14
Phenanthrene	1.28E-13	3.89E-15	1.61E-17	2.11E-18	3.07E-17	8.86E-17	6.40E-19	1.32E-13
Pyrene	6.37E-14	1.95E-15	3.16E-17	3.81E-18	1.50E-17	7.27E-17	3.14E-19	6.58E-14
Parathion	3.60E-18	1.33E-19	1.06E-22	2.09E-23	1.94E-21	6.54E-22	4.04E-23	3.73E-18
Pentachlorobenzene	9.73E-16	4.95E-17	4.02E-19	5.34E-20	5.24E-19	NA	1.09E-20	1.02E-15
Phenol	3.45E-12	6.10E-13	3.50E-18	1.29E-18	1.86E-15	2.10E-17	3.88E-17	4.06E-12
Pyridine	3.06E-17	NA	NA	NA	NA	NA	NA	3.06E-17
Quinoline	1.52E-16	1.15E-17	2.96E-22	1.02E-22	8.21E-20	1.22E-20	1.71E-21	1.64E-16
Styrene	6.40E-13	NA	NA	NA	NA	NA	NA	6.40E-13
Supona	1.08E-17	4.26E-19	9.34E-23	2.42E-23	5.82E-21	2.13E-21	1.21E-22	1.12E-17
Tetrachlorobenzene	4.10E-16	3.44E-17	3.69E-20	5.91E-21	2.21E-19	NA	4.61E-21	4.45E-16
Tetrachloroethene	2.54E-15	NA	NA	NA	NA	NA	NA	2.54E-15
Toluene	3.19E-13	NA	NA	NA	NA	NA	NA	3.19E-13
Trichlorobenzene	2.16E-16	7.01E-18	8.86E-21	1.63E-21	1.16E-19	9.56E-20	2.43E-21	2.24E-16
Trichloroethene	3.91E-16	NA	NA	NA	NA	NA	NA	3.91E-16
Urea	4.68E-12	7.52E-11	5.95E-20	2.33E-20	2.52E-15	6.01E-17	5.25E-17	7.99E-11
Vapona	2.88E-17	2.26E-18	2.74E-23	1.01E-23	1.55E-20	8.82E-22	3.23E-22	3.11E-17
Vinyl Chloride	6.38E-13	NA	NA	NA	NA	NA	NA	6.38E-13
Xylene	1.28E-13	NA	NA	NA	NA	NA	NA	1.28E-13
INORGANICS								
Aluminum	8.46E-08	NA	NA	NA	NA	NE	NA	8.46E-08
Ammonia	1.52E-08	NA	NA	NA	NA	NA	NA	1.52E-08
Antimony	2.97E-09	7.87E-11	1.21E-13	4.98E-14	1.60E-12	NA	3.33E-15	3.05E-09
Arsenic	1.68E-08	4.40E-10	4.56E-11	5.59E-13	9.05E-12	1.49E-11	1.89E-14	1.73E-08
Barium	4.12E-09	1.08E-10	6.08E-13	1.01E-14	2.22E-12	NE	4.62E-15	4.23E-09
Beryllium	1.72E-10	4.49E-12	6.09E-17	2.47E-15	9.26E-14	7.67E-15	1.93E-16	1.77E-10
Boron	1.25E-07	NA	NA	NA	NA	NE	NA	1.25E-07
Cadmium	4.90E-10	NA	NA	NA	NA	3.78E-13	NA	4.90E-10
Calcium	7.20E-07	NA	NA	NA	NA	NA	NA	7.20E-07
Chromium (III)	1.12E-09	NA	NA	NA	NA	NA	NA	1.12E-09
Chromium (VI)	3.93E-11	NA	NA	NA	NA	1.43E-14	NA	3.94E-11
Cobalt	3.70E-09	NA	NA	NA	NA	1.74E-13	NA	3.70E-09
Copper	1.58E-05	4.49E-07	1.29E-08	4.85E-09	8.49E-09	4.48E-08	1.77E-11	1.63E-05
Cyanogen	3.06E-17	NA	NA	NA	NA	NA	NA	3.06E-17
Hydrogen Cyanide	3.02E-13	NA	NA	NA	NA	NA	NA	3.02E-13
Iron	2.24E-07	NA	NA	NA	NA	NE	NA	2.24E-07
Lead	5.28E-09	1.38E-10	5.54E-13	2.66E-14	2.84E-12	2.28E-12	5.92E-15	5.42E-09
Lithium	5.16E-10	NA	NA	NA	NA	NE	NA	5.16E-10
Magnesium	6.70E-07	NA	NA	NA	NA	NE	NA	6.70E-07

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Table 8-4
(continued)

Manganese	2.89E-08	NA	NA	NA	NA	NA	NA	2.89E-08
Mercury	4.65E-09	1.33E-10	1.07E-12	3.66E-11	2.51E-12	NA	5.22E-15	4.82E-09
Molybdenum	5.17E-08	NA	NA	NA	NA	NE	NA	5.17E-08
Nickel	1.34E-07	NA	NA	NA	NA	NA	NA	1.34E-07
Phosphate	1.56E-05	NA	NA	NA	NA	NA	NA	1.56E-05
Potassium	5.33E-06	NA	NA	NA	NA	NA	NA	5.33E-06
Selenium	4.31E-05	1.13E-06	7.89E-08	1.18E-08	2.32E-08	1.75E-09	4.84E-11	4.44E-05
Silicon	7.43E-07	NA	NA	NA	NA	NA	NA	7.43E-07
Silver	4.47E-07	1.22E-08	4.51E-09	3.32E-11	2.41E-10	3.46E-09	5.02E-13	4.67E-07
Sodium	5.49E-04	NA	NA	NA	NA	NA	NA	5.49E-04
Strontium	1.72E-10	NA	NA	NA	NA	NE	NA	1.72E-10
Thallium	4.34E-08	1.13E-09	3.40E-11	2.47E-11	2.34E-11	NA	4.87E-14	4.46E-08
Tin	3.79E-08	NA	NA	NA	NA	NE	NA	3.79E-08
Titanium	2.87E-10	NA	NA	NA	NA	NE	NA	2.87E-10
Vanadium	1.10E-08	NA	NA	NA	NA	2.58E-13	NA	1.10E-08
Yittrium	1.00E-10	NA	NA	NA	NA	NE	NA	1.00E-10
Zinc	7.63E-08	NA	NA	NA	NA	1.06E-10	NA	7.65E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	2.21E-05	NA	NA	NA	NA	NA	NA	2.21E-05
Hydrogen Chloride	2.21E-05	NA	NA	NA	NA	NA	NA	2.21E-05
Hydrogen Fluorides	7.82E-07	NA	NA	NA	NA	NA	NA	7.82E-07
Nitric Acid	1.82E-05	NA	NA	NA	NA	NA	NA	1.82E-05
Nitrogen Dioxide	1.51E-04	NA	NA	NA	NA	NA	NA	1.51E-04
Particulate Matter	6.51E-05	NA	NA	NA	NA	NA	NA	6.51E-05
Sulfur Dioxide	1.15E-04	NA	NA	NA	NA	NA	NA	1.15E-04
Sulfuric Acid Mist	4.82E-05	NA	NA	NA	NA	NA	NA	4.82E-05

NA = Not applicable
NE = Not evaluted

Table 8-5

Average Total Pollutant Daily Intake for the Adult, Resident-B Scenario

Pollutant	Daily Intake (mg/kg/day)							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	7.89E-18	NA	NA	NA	NA	NA	NA	7.89E-18
Acetonitrile	4.79E-16	3.99E-15	4.89E-22	1.92E-22	2.35E-18	8.42E-22	4.90E-20	4.47E-15
Acrylonitrile	4.79E-17	NA	NA	NA	NA	NA	NA	4.79E-17
Aldrin	5.08E-18	9.34E-18	8.33E-20	1.19E-20	2.49E-20	2.08E-22	5.19E-22	1.45E-17
Atrazine	1.13E-18	3.41E-21	5.35E-25	1.22E-25	5.75E-23	0.00E+00	1.20E-24	1.13E-18
Benzaldehyde	1.04E-13	4.53E-14	6.18E-19	2.42E-19	5.10E-16	2.31E-17	1.06E-17	1.50E-13
Benzene	1.03E-13	NA	NA	NA	NA	NA	NA	1.03E-13
Benzofuran	2.00E-13	4.58E-14	3.79E-18	1.47E-18	9.79E-16	1.99E-16	2.04E-17	2.47E-13
Benzoic Acid	5.04E-14	1.41E-14	4.37E-19	1.71E-19	2.47E-16	2.01E-17	5.15E-18	6.48E-14
Benzonitrile	4.79E-17	1.90E-17	3.08E-22	1.20E-22	2.35E-19	1.18E-20	4.90E-21	6.72E-17
Biphenyl	5.00E-14	NA	NA	NA	NA	NA	NA	5.00E-14
Bromomethane	1.00E-14	NA	NA	NA	NA	NA	NA	1.00E-14
Carbazole	9.59E-18	1.34E-18	3.38E-22	1.29E-22	4.70E-20	1.27E-20	9.80E-22	1.10E-17
Carbon Tetrachloride	3.18E-17	NA	NA	NA	NA	NA	NA	3.18E-17
Chlorobenzene	2.47E-14	NA	NA	NA	NA	NA	NA	2.47E-14
4-Chlorobiphenyl	5.79E-14	3.41E-15	1.20E-17	3.98E-18	2.84E-16	5.60E-17	5.92E-18	6.17E-14
4,4-Chlorobiphenyl	7.59E-16	3.35E-17	4.05E-19	1.12E-19	3.72E-18	2.45E-19	7.75E-20	7.97E-16
Chloroform	5.04E-18	NA	NA	NA	NA	NA	NA	5.04E-18
4-Chlorophenylmethylsulfone	1.85E-17	2.41E-19	1.91E-24	7.02E-25	1.89E-21	2.95E-21	3.94E-23	1.88E-17
4-Chlorophenylmethylsulfoxide	6.90E-17	8.21E-19	8.21E-24	2.98E-24	7.03E-21	1.09E-20	1.47E-22	6.98E-17
p,p-DDE	8.45E-15	1.06E-17	2.95E-18	4.84E-19	7.73E-18	6.36E-16	1.61E-19	9.10E-15
p,p-DDT	1.69E-18	3.76E-20	2.46E-21	3.34E-22	1.55E-21	1.33E-19	3.22E-23	1.87E-18
Dibenzofuran	9.98E-15	8.54E-16	8.36E-19	3.06E-19	4.89E-17	1.97E-17	1.02E-18	1.09E-14
Dichlorobenzenes (total)	1.80E-17	NA	NA	NA	NA	NA	NA	1.80E-17
1,4-Dichlorobenzene	1.14E-18	NA	NA	NA	NA	NA	NA	1.14E-18
1,1-Dichloroethene	2.79E-17	NA	NA	NA	NA	NA	NA	2.79E-17
1,2-Dichloroethene	1.94E-17	NA	NA	NA	NA	NA	NA	1.94E-17
1,2-Dichloropropane	2.26E-18	NA	NA	NA	NA	NA	NA	2.26E-18
Dieldrin	1.04E-18	1.29E-17	1.55E-21	3.40E-22	5.11E-21	8.91E-21	1.07E-22	1.40E-17
Diisopropyl Methylphosphonate	1.83E-16	2.61E-18	6.33E-23	2.32E-23	3.74E-20	5.61E-20	7.80E-22	1.86E-16
1,3-Dimethylbenzene	2.00E-14	2.98E-15	6.43E-19	2.47E-19	9.79E-17	2.58E-17	2.04E-18	2.31E-14
Dimethyldisulfide	5.08E-16	NA	NA	NA	NA	NA	NA	5.08E-16
Dimethyl Methylphosphonate	4.37E-15	1.06E-16	7.25E-25	2.75E-25	1.47E-20	3.07E-19	3.07E-22	4.47E-15
Dimethylphosphate	1.20E-15	7.98E-19	NE	NE	5.87E-18	NE	1.22E-19	1.20E-15
Dioxins/Furans (EPA TEFs)	3.06E-15	6.58E-18	2.06E-18	1.10E-18	3.68E-18	2.24E-17	7.67E-20	3.10E-15
Dithiane	1.83E-19	1.93E-19	5.47E-25	2.14E-25	8.98E-22	1.49E-23	1.87E-23	3.77E-19
Endrin	1.01E-18	1.88E-21	4.58E-23	1.20E-23	1.03E-21	1.26E-21	2.14E-23	1.02E-18
Ethylbenzene	3.00E-14	NA	NA	NA	NA	NA	NA	3.00E-14
Hexachlorobenzene	3.41E-16	5.21E-18	7.03E-20	1.12E-20	2.09E-19	4.41E-18	4.35E-21	3.51E-16
Hexachlorocyclopentadiene	9.45E-18	1.22E-17	4.53E-21	1.28E-21	4.63E-20	6.95E-21	9.65E-22	2.17E-17
Isodrin	2.67E-18	1.68E-17	7.07E-21	1.37E-21	1.31E-20	2.04E-19	2.73E-22	1.97E-17
Malathion	4.08E-18	3.70E-19	9.63E-23	3.73E-23	2.00E-20	0.00E+00	4.17E-22	4.47E-18
Methanol	1.16E-13	9.82E-13	7.42E-20	2.91E-20	5.68E-16	9.50E-18	1.18E-17	1.10E-12

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Table 8-5
(continued)

Methyl Chloride	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Methylene Chloride	1.00E-14	NA	NA	NA	NA	NA	NA	1.00E-14
4-Nitrophenol	4.22E-17	7.87E-18	1.02E-21	3.93E-22	2.07E-19	4.89E-20	4.31E-21	5.04E-17
PAHs								
Acenaphthalene	5.00E-14	1.04E-14	3.97E-18	1.46E-18	2.45E-16	9.49E-17	5.11E-18	6.07E-14
Acenaphthene	5.00E-14	4.80E-15	3.38E-18	1.26E-18	2.45E-16	3.68E-17	5.11E-18	5.51E-14
Benzo(a)pyrene	9.98E-15	7.72E-18	1.54E-17	1.76E-18	8.62E-19	1.26E-17	1.80E-20	1.00E-14
Chrysene	9.98E-15	1.81E-17	3.66E-18	4.33E-19	1.08E-18	3.19E-16	2.25E-20	1.03E-14
Dibenzo(a,h)anthracene	9.98E-15	9.34E-18	1.85E-17	2.12E-18	1.17E-18	7.16E-15	2.44E-20	1.72E-14
Fluoranthene	3.00E-14	8.44E-17	3.03E-18	3.80E-19	3.16E-18	NA	6.59E-20	3.01E-14
Fluorene	9.98E-15	1.23E-15	1.12E-18	3.98E-19	4.89E-17	2.64E-17	1.02E-18	1.13E-14
Phenanthrene	2.00E-14	4.07E-17	4.67E-19	6.24E-20	1.50E-18	8.86E-17	3.12E-20	2.01E-14
Pyrene	9.98E-15	2.04E-17	9.08E-19	1.11E-19	7.25E-19	7.27E-17	1.51E-20	1.01E-14
Parathion	5.63E-19	5.70E-20	3.39E-23	1.27E-23	2.76E-21	6.54E-22	5.75E-23	6.24E-19
Pentachlorobenzene	1.52E-16	3.45E-17	4.00E-20	1.27E-20	7.47E-19	NA	1.56E-20	1.88E-16
Phenol	5.41E-13	7.42E-13	3.15E-18	1.23E-18	2.65E-15	2.10E-17	5.52E-17	1.29E-12
Pyridine	4.79E-18	NA	NA	NA	NA	NA	NA	4.79E-18
Quinoline	2.39E-17	1.07E-17	2.42E-22	9.46E-23	1.17E-19	1.22E-20	2.44E-21	3.47E-17
Styrene	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Supona	1.69E-18	2.07E-19	4.97E-23	1.91E-23	8.29E-21	2.13E-21	1.73E-22	1.91E-18
Tetrachlorobenzene	6.43E-17	3.38E-17	7.10E-21	2.54E-21	3.15E-19	NA	6.57E-21	9.84E-17
Tetrachloroethene	3.98E-16	NA	NA	NA	NA	NA	NA	3.98E-16
Toluene	5.00E-14	NA	NA	NA	NA	NA	NA	5.00E-14
Trichlorobenzene	3.39E-17	1.98E-18	2.44E-21	9.04E-22	1.66E-19	9.56E-20	3.46E-21	3.61E-17
Trichloroethene	6.12E-17	NA	NA	NA	NA	NA	NA	6.12E-17
Urea	7.32E-13	1.07E-10	5.87E-20	2.30E-20	3.59E-15	6.01E-17	7.48E-17	1.08E-10
Vapona	4.51E-18	2.16E-18	2.48E-23	9.70E-24	2.21E-20	8.82E-22	4.61E-22	6.69E-18
Vinyl Chloride	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Xylene	2.00E-14	NA	NA	NA	NA	NA	NA	2.00E-14
INORGANICS								
Aluminum	1.32E-08	NA	NA	NA	NA	NE	NA	1.32E-08
Ammonia	2.39E-09	NA	NA	NA	NA	NA	NA	2.39E-09
Antimony	4.65E-10	2.14E-12	8.40E-15	8.71E-15	2.28E-12	NA	4.75E-15	4.70E-10
Arsenic	2.63E-09	3.82E-12	7.18E-12	9.39E-14	1.29E-11	1.49E-11	2.69E-14	2.67E-09
Barium	6.45E-10	1.97E-12	5.98E-14	1.52E-15	3.16E-12	NE	6.59E-15	6.50E-10
Beryllium	2.69E-11	2.32E-14	2.07E-18	9.99E-17	1.32E-13	7.67E-15	2.75E-16	2.71E-11
Boron	1.96E-08	NA	NA	NA	NA	NE	NA	1.96E-08
Cadmium	7.67E-11	NA	NA	NA	NA	3.78E-13	NA	7.71E-11
Calcium	1.13E-07	NA	NA	NA	NA	NA	NA	1.13E-07
Chromium (III)	1.75E-10	NA	NA	NA	NA	NA	NA	1.75E-10
Chromium (VI)	6.16E-12	NA	NA	NA	NA	1.43E-14	NA	6.17E-12
Cobalt	5.79E-10	NA	NA	NA	NA	1.74E-13	NA	5.80E-10
Copper	2.47E-06	5.60E-08	3.86E-09	2.64E-09	1.21E-08	4.48E-08	2.52E-11	2.59E-06
Cyanogen	4.79E-18	NA	NA	NA	NA	NA	NA	4.79E-18
Hydrogen Cyanide	4.73E-14	NA	NA	NA	NA	NA	NA	4.73E-14
Iron	3.51E-08	NA	NA	NA	NA	NE	NA	3.51E-08
Lead	8.26E-10	1.42E-12	5.22E-14	4.75E-15	4.05E-12	2.28E-12	8.44E-15	8.34E-10
Lithium	8.08E-11	NA	NA	NA	NA	NE	NA	8.08E-11
Magnesium	1.05E-07	NA	NA	NA	NA	NE	NA	1.05E-07

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Table 8-5
(continued)

Manganese	4.53E-09	NA	NA	NA	NA	NA	NA	4.53E-09
Mercury	7.28E-10	1.69E-11	2.75E-13	2.03E-11	3.57E-12	NA	7.44E-15	7.69E-10
Molybdenum	8.10E-09	NA	NA	NA	NA	NE	NA	8.10E-09
Nickel	2.10E-08	NA	NA	NA	NA	NA	NA	2.10E-08
Phosphate	2.45E-06	NA	NA	NA	NA	NA	NA	2.45E-06
Potassium	8.34E-07	NA	NA	NA	NA	NA	NA	8.34E-07
Selenium	6.75E-06	1.85E-08	1.32E-08	2.82E-09	3.31E-08	1.75E-09	6.90E-11	6.82E-06
Silicon	1.16E-07	NA	NA	NA	NA	NA	NA	1.16E-07
Silver	7.00E-08	8.05E-10	1.09E-09	1.45E-11	3.43E-10	3.46E-09	7.15E-13	7.57E-08
Sodium	8.59E-05	NA	NA	NA	NA	NA	NA	8.59E-05
Strontium	2.69E-11	NA	NA	NA	NA	NE	NA	2.69E-11
Thallium	6.79E-09	4.96E-12	1.04E-12	7.97E-13	3.33E-11	NA	6.94E-14	6.83E-09
Tin	5.94E-09	NA	NA	NA	NA	NE	NA	5.94E-09
Titanium	4.49E-11	NA	NA	NA	NA	NE	NA	4.49E-11
Vanadium	1.72E-09	NA	NA	NA	NA	2.58E-13	NA	1.72E-09
Yittrium	1.57E-11	NA	NA	NA	NA	NE	NA	1.57E-11
Zinc	1.20E-08	NA	NA	NA	NA	1.06E-10	NA	1.21E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	3.47E-06	NA	NA	NA	NA	NA	NA	3.47E-06
Hydrogen Chloride	3.47E-06	NA	NA	NA	NA	NA	NA	3.47E-06
Hydrogen Fluorides	1.22E-07	NA	NA	NA	NA	NA	NA	1.22E-07
Nitric Acid	2.86E-06	NA	NA	NA	NA	NA	NA	2.86E-06
Nitrogen Dioxide	2.37E-05	NA	NA	NA	NA	NA	NA	2.37E-05
Particulate Matter	1.02E-05	NA	NA	NA	NA	NA	NA	1.02E-05
Sulfur Dioxide	1.80E-05	NA	NA	NA	NA	NA	NA	1.80E-05
Sulfuric Acid Mist	7.55E-06	NA	NA	NA	NA	NA	NA	7.55E-06

NA = Not applicable
NE = Not evaluted

Table 8-6

Maximum Total Pollutant Daily Intake for the Adult, Resident-B Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	7.89E-18	NA	NA	NA	NA	NA	NA	7.89E-18
Acetonitrile	4.79E-16	4.06E-15	5.00E-22	1.95E-22	2.38E-18	8.42E-22	4.97E-20	4.54E-15
Acrylonitrile	4.79E-17	NA	NA	NA	NA	NA	NA	4.79E-17
Aldrin	5.08E-18	9.59E-18	2.60E-18	2.94E-19	2.53E-20	2.08E-22	5.27E-22	1.76E-17
Atrazine	1.13E-18	1.13E-19	1.82E-23	4.08E-24	1.89E-21	0.00E+00	3.93E-23	1.24E-18
Benzaldehyde	1.04E-13	4.83E-14	6.89E-19	2.52E-19	5.17E-16	2.31E-17	1.08E-17	1.53E-13
Benzene	1.03E-13	NA	NA	NA	NA	NA	NA	1.03E-13
Benzofuran	2.00E-13	5.10E-14	5.69E-18	1.70E-18	9.93E-16	1.99E-16	2.07E-17	2.52E-13
Benzoic Acid	5.04E-14	1.55E-14	5.17E-19	1.82E-19	2.51E-16	2.01E-17	5.22E-18	6.61E-14
Benzonitrile	4.79E-17	2.04E-17	3.47E-22	1.26E-22	2.38E-19	1.18E-20	4.97E-21	6.86E-17
Biphenyl	5.00E-14	NA	NA	NA	NA	NA	NA	5.00E-14
Bromomethane	1.00E-14	NA	NA	NA	NA	NA	NA	1.00E-14
Carbazole	9.59E-18	1.58E-18	7.12E-22	1.73E-22	4.77E-20	1.27E-20	9.94E-22	1.12E-17
Carbon Tetrachloride	3.18E-17	NA	NA	NA	NA	NA	NA	3.18E-17
Chlorobenzene	2.47E-14	NA	NA	NA	NA	NA	NA	2.47E-14
4-Chlorobiphenyl	5.79E-14	4.78E-15	1.03E-16	1.42E-17	2.88E-16	5.60E-17	6.01E-18	6.32E-14
4,4-Chlorobiphenyl	7.59E-16	5.11E-17	6.10E-18	7.51E-19	3.77E-18	2.45E-19	7.87E-20	8.21E-16
Chloroform	5.04E-18	NA	NA	NA	NA	NA	NA	5.04E-18
4-Chlorophenylmethylsulfone	1.85E-17	6.44E-18	5.17E-23	1.86E-23	4.96E-20	2.95E-21	1.03E-21	2.50E-17
4-Chlorophenylmethylsulfoxide	6.90E-17	2.19E-17	2.23E-22	7.91E-23	1.85E-19	1.09E-20	3.85E-21	9.11E-17
p,p-DDE	8.45E-15	2.22E-16	8.68E-17	1.05E-17	3.88E-17	6.36E-16	8.09E-19	9.44E-15
p,p-DDT	1.69E-18	2.22E-19	7.98E-20	9.24E-21	7.77E-21	1.33E-19	1.62E-22	2.14E-18
Dibenzofuran	9.98E-15	1.09E-15	3.44E-18	6.02E-19	4.96E-17	1.97E-17	1.03E-18	1.11E-14
Dichlorobenzenes (total)	1.80E-17	NA	NA	NA	NA	NA	NA	1.80E-17
1,4-Dichlorobenzene	1.14E-18	NA	NA	NA	NA	NA	NA	1.14E-18
1,1-Dichloroethene	2.79E-17	NA	NA	NA	NA	NA	NA	2.79E-17
1,2-Dichloroethene	1.94E-17	NA	NA	NA	NA	NA	NA	1.94E-17
1,2-Dichloropropane	2.26E-18	NA	NA	NA	NA	NA	NA	2.26E-18
Dieldrin	1.04E-18	1.31E-17	3.42E-20	4.00E-21	5.18E-21	8.91E-21	1.08E-22	1.42E-17
Diisopropyl Methylphosphonate	1.83E-16	4.78E-17	1.21E-21	4.17E-22	6.55E-19	5.61E-20	1.36E-20	2.32E-16
1,3-Dimethylbenzene	2.00E-14	3.48E-15	1.28E-18	3.20E-19	9.93E-17	2.58E-17	2.07E-18	2.36E-14
Dimethyldisulfide	5.08E-16	NA	NA	NA	NA	NA	NA	5.08E-16
Dimethyl Methylphosphonate	4.37E-15	3.72E-15	2.54E-23	9.62E-24	5.16E-19	3.07E-19	1.08E-20	8.09E-15
Dimethylphosphate	1.20E-15	2.79E-17	NE	NE	5.96E-18	NE	1.24E-19	1.23E-15
Dioxins/Furans (EPA TEFs)	3.06E-15	8.90E-17	6.26E-17	2.56E-17	1.43E-17	2.24E-17	2.98E-19	3.27E-15
Dithiane	1.83E-19	2.00E-19	5.76E-25	2.20E-25	9.11E-22	1.49E-23	1.90E-23	3.84E-19
Endrin	1.01E-18	2.92E-20	8.60E-22	1.28E-22	4.69E-21	1.26E-21	9.78E-23	1.05E-18
Ethylbenzene	3.00E-14	NA	NA	NA	NA	NA	NA	3.00E-14
Hexachlorobenzene	3.41E-16	4.39E-17	2.13E-18	2.63E-19	1.51E-18	4.41E-18	3.14E-20	3.93E-16
Hexachlorocyclopentadiene	9.45E-18	1.26E-17	6.49E-20	8.06E-21	4.70E-20	6.95E-21	9.79E-22	2.22E-17
Isodrin	2.67E-18	1.71E-17	1.78E-19	2.05E-20	1.33E-20	2.04E-19	2.77E-22	2.02E-17
Malathion	4.08E-18	4.68E-19	1.60E-22	4.48E-23	2.03E-20	0.00E+00	4.23E-22	4.57E-18
Methanol	1.16E-13	9.99E-13	7.57E-20	2.96E-20	5.76E-16	9.50E-18	1.20E-17	1.12E-12

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Table 8-6
(continued)

Methyl Chloride	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Methylene Chloride	1.00E-14	NA	NA	NA	NA	NA	NA	1.00E-14
4-Nitrophenol	4.22E-17	8.94E-18	1.71E-21	4.75E-22	2.10E-19	4.89E-20	4.38E-21	5.14E-17
PAHs								
Acenaphthalene	5.00E-14	1.17E-14	1.56E-17	2.78E-18	2.49E-16	9.49E-17	5.18E-18	6.20E-14
Acenaphthene	5.00E-14	6.00E-15	1.16E-17	2.19E-18	2.49E-16	3.68E-17	5.18E-18	5.63E-14
Benzo(a)pyrene	9.98E-15	2.63E-16	5.37E-16	6.11E-17	2.43E-17	1.26E-17	5.06E-19	1.09E-14
Chrysene	9.98E-15	5.25E-16	1.27E-16	1.49E-17	2.76E-17	3.19E-16	5.74E-19	1.10E-14
Dibenzo(a,h)anthracene	9.98E-15	2.99E-16	6.46E-16	7.36E-17	2.87E-17	7.16E-15	5.99E-19	1.82E-14
Fluoranthene	3.00E-14	2.36E-15	1.05E-16	1.28E-17	8.17E-17	NA	1.70E-18	3.26E-14
Fluorene	9.98E-15	1.47E-15	5.85E-18	9.33E-19	4.96E-17	2.64E-17	1.03E-18	1.15E-14
Phenanthrene	2.00E-14	1.28E-15	1.61E-17	2.11E-18	4.44E-17	8.86E-17	9.26E-19	2.14E-14
Pyrene	9.98E-15	6.47E-16	3.16E-17	3.81E-18	2.17E-17	7.27E-17	4.53E-19	1.08E-14
Parathion	5.63E-19	7.06E-20	1.06E-22	2.09E-23	2.80E-21	6.54E-22	5.84E-23	6.37E-19
Pentachlorobenzene	1.52E-16	3.84E-17	4.02E-19	5.34E-20	7.58E-19	NA	1.58E-20	1.92E-16
Phenol	5.41E-13	7.65E-13	3.50E-18	1.29E-18	2.69E-15	2.10E-17	5.60E-17	1.31E-12
Pyridine	4.79E-18	NA	NA	NA	NA	NA	NA	4.79E-18
Quinoline	2.39E-17	1.14E-17	2.96E-22	1.02E-22	1.19E-19	1.22E-20	2.47E-21	3.54E-17
Styrene	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Supona	1.69E-18	2.48E-19	9.34E-23	2.42E-23	8.41E-21	2.13E-21	1.75E-22	1.95E-18
Tetrachlorobenzene	6.43E-17	3.57E-17	3.69E-20	5.91E-21	3.20E-19	NA	6.66E-21	1.00E-16
Tetrachloroethene	3.98E-16	NA	NA	NA	NA	NA	NA	3.98E-16
Toluene	5.00E-14	NA	NA	NA	NA	NA	NA	5.00E-14
Trichlorobenzene	3.39E-17	2.77E-18	8.86E-21	1.63E-21	1.68E-19	9.56E-20	3.51E-21	3.69E-17
Trichloroethene	6.12E-17	NA	NA	NA	NA	NA	NA	6.12E-17
Urea	7.32E-13	1.09E-10	5.95E-20	2.33E-20	3.64E-15	6.01E-17	7.59E-17	1.09E-10
Vapona	4.51E-18	2.29E-18	2.74E-23	1.01E-23	2.24E-20	8.82E-22	4.67E-22	6.83E-18
Vinyl Chloride	1.00E-13	NA	NA	NA	NA	NA	NA	1.00E-13
Xylene	2.00E-14	NA	NA	NA	NA	NA	NA	2.00E-14
INORGANICS								
Aluminum	1.32E-08	NA	NA	NA	NA	NE	NA	1.32E-08
Ammonia	2.39E-09	NA	NA	NA	NA	NA	NA	2.39E-09
Antimony	4.65E-10	1.27E-11	1.21E-13	4.98E-14	2.31E-12	NA	4.82E-15	4.80E-10
Arsenic	2.63E-09	6.35E-11	4.56E-11	5.59E-13	1.31E-11	1.49E-11	2.73E-14	2.77E-09
Barium	6.45E-10	1.66E-11	6.08E-13	1.01E-14	3.21E-12	NE	6.68E-15	6.65E-10
Beryllium	2.69E-11	6.33E-13	6.09E-17	2.47E-15	1.34E-13	7.67E-15	2.79E-16	2.77E-11
Boron	1.96E-08	NA	NA	NA	NA	NE	NA	1.96E-08
Cadmium	7.67E-11	NA	NA	NA	NA	3.78E-13	NA	7.71E-11
Calcium	1.13E-07	NA	NA	NA	NA	NA	NA	1.13E-07
Chromium (III)	1.75E-10	NA	NA	NA	NA	NA	NA	1.75E-10
Chromium (VI)	6.16E-12	NA	NA	NA	NA	1.43E-14	NA	6.17E-12
Cobalt	5.79E-10	NA	NA	NA	NA	1.74E-13	NA	5.80E-10
Copper	2.47E-06	1.13E-07	1.29E-08	4.85E-09	1.23E-08	4.48E-08	2.56E-11	2.66E-06
Cyanogen	4.79E-18	NA	NA	NA	NA	NA	NA	4.79E-18
Hydrogen Cyanide	4.73E-14	NA	NA	NA	NA	NA	NA	4.73E-14
Iron	3.51E-08	NA	NA	NA	NA	NE	NA	3.51E-08
Lead	8.26E-10	2.02E-11	5.54E-13	2.66E-14	4.11E-12	2.28E-12	8.56E-15	8.53E-10
Lithium	8.08E-11	NA	NA	NA	NA	NE	NA	8.08E-11
Magnesium	1.05E-07	NA	NA	NA	NA	NE	NA	1.05E-07

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Table 8-6
(continued)

Manganese	4.53E-09	NA	NA	NA	NA	NA	NA	4.53E-09
Mercury	7.28E-10	3.36E-11	1.07E-12	3.66E-11	3.62E-12	NA	7.55E-15	8.03E-10
Molybdenum	8.10E-09	NA	NA	NA	NA	NE	NA	8.10E-09
Nickel	2.10E-08	NA	NA	NA	NA	NA	NA	2.10E-08
Phosphate	2.45E-06	NA	NA	NA	NA	NA	NA	2.45E-06
Potassium	8.34E-07	NA	NA	NA	NA	NA	NA	8.34E-07
Selenium	6.75E-06	1.72E-07	7.89E-08	1.18E-08	3.36E-08	1.75E-09	7.00E-11	7.05E-06
Silicon	1.16E-07	NA	NA	NA	NA	NA	NA	1.16E-07
Silver	7.00E-08	2.40E-09	4.51E-09	3.32E-11	3.48E-10	3.46E-09	7.25E-13	8.07E-08
Sodium	8.59E-05	NA	NA	NA	NA	NA	NA	8.59E-05
Strontium	2.69E-11	NA	NA	NA	NA	NE	NA	2.69E-11
Thallium	6.79E-09	1.59E-10	3.40E-11	2.47E-11	3.38E-11	NA	7.04E-14	7.04E-09
Tin	5.94E-09	NA	NA	NA	NA	NE	NA	5.94E-09
Titanium	4.49E-11	NA	NA	NA	NA	NE	NA	4.49E-11
Vanadium	1.72E-09	NA	NA	NA	NA	2.58E-13	NA	1.72E-09
Yittrium	1.57E-11	NA	NA	NA	NA	NE	NA	1.57E-11
Zinc	1.20E-08	NA	NA	NA	NA	1.06E-10	NA	1.21E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	3.47E-06	NA	NA	NA	NA	NA	NA	3.47E-06
Hydrogen Chloride	3.47E-06	NA	NA	NA	NA	NA	NA	3.47E-06
Hydrogen Fluorides	1.22E-07	NA	NA	NA	NA	NA	NA	1.22E-07
Nitric Acid	2.86E-06	NA	NA	NA	NA	NA	NA	2.86E-06
Nitrogen Dioxide	2.37E-05	NA	NA	NA	NA	NA	NA	2.37E-05
Particulate Matter	1.02E-05	NA	NA	NA	NA	NA	NA	1.02E-05
Sulfur Dioxide	1.80E-05	NA	NA	NA	NA	NA	NA	1.80E-05
Sulfuric Acid Mist	7.55E-06	NA	NA	NA	NA	NA	NA	7.55E-06

NA = Not applicable
NE = Not evaluted

Table 8-7

Average Total Pollutant Daily Intake for the Adult, Farmer Scenario

Pollutant	Daily Intake (mg/kg/day)							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	1.77E-17	NA	NA	NA	NA	NA	NA	1.77E-17
Acetonitrile	1.07E-15	1.27E-14	9.77E-21	3.83E-21	1.39E-18	8.42E-22	3.32E-19	1.37E-14
Acrylonitrile	1.07E-16	NA	NA	NA	NA	NA	NA	1.07E-16
Aldrin	1.14E-17	4.80E-17	1.67E-18	2.38E-19	1.48E-20	2.08E-22	3.52E-21	6.13E-17
Atrazine	2.53E-18	1.31E-20	1.07E-23	2.44E-24	3.41E-23	0.00E+00	8.13E-24	2.54E-18
Benzaldehyde	2.33E-13	8.37E-14	1.24E-17	4.84E-18	3.02E-16	2.31E-17	7.21E-17	3.17E-13
Benzene	2.30E-13	NA	NA	NA	NA	NA	NA	2.30E-13
Benzofuran	4.48E-13	1.77E-13	7.59E-17	2.95E-17	5.80E-16	1.99E-16	1.38E-16	6.25E-13
Benzoic Acid	1.13E-13	2.97E-14	8.75E-18	3.42E-18	1.46E-16	2.01E-17	3.49E-17	1.43E-13
Benzonitrile	1.07E-16	3.59E-17	6.16E-21	2.41E-21	1.39E-19	1.18E-20	3.32E-20	1.44E-16
Biphenyl	1.12E-13	NA	NA	NA	NA	NA	NA	1.12E-13
Bromomethane	2.24E-14	NA	NA	NA	NA	NA	NA	2.24E-14
Carbazole	2.15E-17	5.67E-18	6.76E-21	2.59E-21	2.79E-20	1.27E-20	6.64E-21	2.72E-17
Carbon Tetrachloride	7.13E-17	NA	NA	NA	NA	NA	NA	7.13E-17
Chlorobenzene	5.53E-14	NA	NA	NA	NA	NA	NA	5.53E-14
4-Chlorobiphenyl	1.30E-13	1.66E-14	2.41E-16	7.95E-17	1.68E-16	5.60E-17	4.01E-17	1.47E-13
4,4-Chlorobiphenyl	1.70E-15	1.67E-16	8.09E-18	2.23E-18	2.21E-18	2.45E-19	5.26E-19	1.88E-15
Chloroform	1.13E-17	NA	NA	NA	NA	NA	NA	1.13E-17
4-Chlorophenylmethylsulfone	4.15E-17	4.20E-19	3.83E-23	1.40E-23	1.12E-21	2.95E-21	2.67E-22	4.19E-17
4-Chlorophenylmethylsulfoxide	1.55E-16	1.64E-18	1.64E-22	5.96E-23	4.17E-21	1.09E-20	9.95E-22	1.56E-16
p,p-DDE	1.89E-14	3.89E-17	5.90E-17	9.68E-18	4.58E-18	6.36E-16	1.09E-18	1.97E-14
p,p-DDT	3.79E-18	1.91E-19	4.92E-20	6.69E-21	9.17E-22	1.33E-19	2.19E-22	4.17E-18
Dibenzofuran	2.24E-14	3.95E-15	1.67E-17	6.13E-18	2.90E-17	1.97E-17	6.91E-18	2.64E-14
Dichlorobenzenes (total)	4.03E-17	NA	NA	NA	NA	NA	NA	4.03E-17
1,4-Dichlorobenzene	2.55E-18	NA	NA	NA	NA	NA	NA	2.55E-18
1,1-Dichloroethene	6.26E-17	NA	NA	NA	NA	NA	NA	6.26E-17
1,2-Dichloroethene	4.36E-17	NA	NA	NA	NA	NA	NA	4.36E-17
1,2-Dichloropropane	5.07E-18	NA	NA	NA	NA	NA	NA	5.07E-18
Dieldrin	2.34E-18	6.62E-17	3.10E-20	6.80E-21	3.03E-21	8.91E-21	7.22E-22	6.86E-17
Diisopropyl Methylphosphonate	4.11E-16	5.42E-18	1.27E-21	4.64E-22	2.22E-20	5.61E-20	5.29E-21	4.16E-16
1,3-Dimethylbenzene	4.48E-14	1.24E-14	1.29E-17	4.94E-18	5.80E-17	2.58E-17	1.38E-17	5.73E-14
Dimethyldisulfide	1.14E-15	NA	NA	NA	NA	NA	NA	1.14E-15
Dimethyl Methylphosphonate	9.78E-15	1.59E-16	1.45E-23	5.50E-24	8.74E-21	3.07E-19	2.08E-21	9.94E-15
Dimethylphosphate	2.68E-15	3.05E-18	NE	NE	3.48E-18	NE	8.30E-19	2.69E-15
Dioxins/Furans (EPA TEFs)	6.86E-15	2.89E-17	4.12E-17	2.20E-17	2.18E-18	2.24E-17	5.20E-19	6.97E-15
Dithiane	4.11E-19	3.15E-19	1.09E-23	4.29E-24	5.32E-22	1.49E-23	1.27E-22	7.26E-19
Endrin	2.27E-18	3.87E-21	9.15E-22	2.39E-22	6.09E-22	1.26E-21	1.45E-22	2.28E-18
Ethylbenzene	6.72E-14	NA	NA	NA	NA	NA	NA	6.72E-14
Hexachlorobenzene	7.63E-16	2.62E-17	1.41E-18	2.25E-19	1.24E-19	4.41E-18	2.95E-20	7.96E-16
Hexachlorocyclopentadiene	2.12E-17	6.26E-17	9.06E-20	2.56E-20	2.75E-20	6.95E-21	6.54E-21	8.40E-17
Isodrin	5.99E-18	8.62E-17	1.41E-19	2.73E-20	7.77E-21	2.04E-19	1.85E-21	9.26E-17
Malathion	9.14E-18	1.01E-18	1.93E-21	7.45E-22	1.19E-20	0.00E+00	2.83E-21	1.02E-17
Methanol	2.60E-13	1.46E-12	1.48E-18	5.82E-19	3.37E-16	9.50E-18	8.03E-17	1.72E-12

Table 8-7
(continued)

Methyl Chloride	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Methylene Chloride	2.24E-14	NA	NA	NA	NA	NA	NA	2.24E-14
4-Nitrophenol	9.46E-17	3.14E-17	2.03E-20	7.87E-21	1.23E-19	4.89E-20	2.93E-20	1.26E-16
PAHs								
Acenaphthalene	1.12E-13	5.10E-14	7.93E-17	2.92E-17	1.45E-16	9.49E-17	3.46E-17	1.63E-13
Acenaphthene	1.12E-13	2.19E-14	6.75E-17	2.51E-17	1.45E-16	3.68E-17	3.46E-17	1.34E-13
Benzo(a)pyrene	2.24E-14	3.06E-17	3.07E-16	3.51E-17	5.11E-19	1.26E-17	1.22E-19	2.27E-14
Chrysene	2.24E-14	8.31E-17	7.31E-17	8.67E-18	6.40E-19	3.19E-16	1.53E-19	2.28E-14
Dibenzo(a,h)anthracene	2.24E-14	3.88E-17	3.70E-16	4.25E-17	6.95E-19	7.16E-15	1.66E-19	3.00E-14
Fluoranthene	6.72E-14	4.01E-16	6.06E-17	7.59E-18	1.87E-18	NA	4.47E-19	6.77E-14
Fluorene	2.24E-14	6.01E-15	2.23E-17	7.97E-18	2.90E-17	2.64E-17	6.91E-18	2.85E-14
Phenanthrene	4.48E-14	1.84E-16	9.33E-18	1.25E-18	8.87E-19	8.86E-17	2.11E-19	4.50E-14
Pyrene	2.24E-14	9.48E-17	1.82E-17	2.21E-18	4.30E-19	7.27E-17	1.02E-19	2.25E-14
Parathion	1.26E-18	2.56E-19	6.77E-22	2.54E-22	1.64E-21	6.54E-22	3.90E-22	1.52E-18
Pentachlorobenzene	3.41E-16	1.75E-16	8.00E-19	2.54E-19	4.43E-19	NA	1.06E-19	5.18E-16
Phenol	1.21E-12	3.01E-12	6.30E-17	2.47E-17	1.57E-15	2.10E-17	3.75E-16	4.23E-12
Pyridine	1.07E-17	NA	NA	NA	NA	NA	NA	1.07E-17
Quinoline	5.35E-17	3.86E-17	4.84E-21	1.89E-21	6.94E-20	1.22E-20	1.65E-20	9.22E-17
Styrene	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Supona	3.79E-18	7.86E-19	9.95E-22	3.83E-22	4.92E-21	2.13E-21	1.17E-21	4.59E-18
Tetrachlorobenzene	1.44E-16	1.72E-16	1.42E-19	5.08E-20	1.87E-19	NA	4.45E-20	3.16E-16
Tetrachloroethene	8.91E-16	NA	NA	NA	NA	NA	NA	8.91E-16
Toluene	1.12E-13	NA	NA	NA	NA	NA	NA	1.12E-13
Trichlorobenzene	7.59E-17	8.40E-18	4.88E-20	1.81E-20	9.84E-20	9.56E-20	2.35E-20	8.46E-17
Trichloroethene	1.37E-16	NA	NA	NA	NA	NA	NA	1.37E-16
Urea	1.64E-12	1.50E-10	1.17E-18	4.60E-19	2.13E-15	6.01E-17	5.07E-16	1.51E-10
Vapona	1.01E-17	3.90E-18	4.96E-22	1.94E-22	1.31E-20	8.82E-22	3.12E-21	1.40E-17
Vinyl Chloride	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Xylene	4.48E-14	NA	NA	NA	NA	NA	NA	4.48E-14
INORGANICS								
Aluminum	2.97E-08	NA	NA	NA	NA	NE	NA	2.97E-08
Ammonia	5.35E-09	NA	NA	NA	NA	NA	NA	5.35E-09
Antimony	1.04E-09	4.04E-12	1.68E-13	1.74E-13	1.35E-12	NA	3.22E-14	1.05E-09
Arsenic	5.90E-09	9.93E-12	1.44E-10	1.88E-12	7.65E-12	1.49E-11	1.82E-13	6.08E-09
Barium	1.44E-09	3.87E-12	1.20E-12	3.03E-14	1.87E-12	NE	4.47E-14	1.45E-09
Beryllium	6.03E-11	7.68E-14	4.15E-17	2.00E-15	7.83E-14	7.67E-15	1.87E-15	6.05E-11
Boron	4.40E-08	NA	NA	NA	NA	NE	NA	4.40E-08
Cadmium	1.72E-10	NA	NA	NA	NA	3.78E-13	NA	1.72E-10
Calcium	2.53E-07	NA	NA	NA	NA	NA	NA	2.53E-07
Chromium (III)	3.92E-10	NA	NA	NA	NA	NA	NA	3.92E-10
Chromium (VI)	1.38E-11	NA	NA	NA	NA	1.43E-14	NA	1.38E-11
Cobalt	1.30E-09	NA	NA	NA	NA	1.74E-13	NA	1.30E-09
Copper	5.53E-06	1.08E-07	7.71E-08	5.27E-08	7.17E-09	4.48E-08	1.71E-10	5.82E-06
Cyanogen	1.07E-17	NA	NA	NA	NA	NA	NA	1.07E-17
Hydrogen Cyanide	1.06E-13	NA	NA	NA	NA	NA	NA	1.06E-13
Iron	7.86E-08	NA	NA	NA	NA	NE	NA	7.86E-08
Lead	1.85E-09	3.53E-12	1.04E-12	9.49E-14	2.40E-12	2.28E-12	5.72E-14	1.86E-09
Lithium	1.81E-10	NA	NA	NA	NA	NE	NA	1.81E-10
Magnesium	2.35E-07	NA	NA	NA	NA	NE	NA	2.35E-07

DRAFT

Table 8-7
(continued)

Manganese	1.01E-08	NA	NA	NA	NA	NA	NA	1.01E-08
Mercury	1.63E-09	2.92E-11	5.49E-12	4.06E-10	2.12E-12	NA	5.05E-14	2.08E-09
Molybdenum	1.81E-08	NA	NA	NA	NA	NE	NA	1.81E-08
Nickel	4.71E-08	NA	NA	NA	NA	NA	NA	4.71E-08
Phosphate	5.49E-06	NA	NA	NA	NA	NA	NA	5.49E-06
Potassium	1.87E-06	NA	NA	NA	NA	NA	NA	1.87E-06
Selenium	1.51E-05	4.43E-08	2.64E-07	5.64E-08	1.96E-08	1.75E-09	4.68E-10	1.55E-05
Silicon	2.61E-07	NA	NA	NA	NA	NA	NA	2.61E-07
Silver	1.57E-07	1.46E-09	2.18E-08	2.89E-10	2.03E-10	3.46E-09	4.85E-12	1.84E-07
Sodium	1.92E-04	NA	NA	NA	NA	NA	NA	1.92E-04
Strontium	6.03E-11	NA	NA	NA	NA	NE	NA	6.03E-11
Thallium	1.52E-08	1.79E-11	2.07E-11	1.59E-11	1.97E-11	NA	4.71E-13	1.53E-08
Tin	1.33E-08	NA	NA	NA	NA	NE	NA	1.33E-08
Titanium	1.01E-10	NA	NA	NA	NA	NE	NA	1.01E-10
Vanadium	3.85E-09	NA	NA	NA	NA	2.58E-13	NA	3.85E-09
Yittrium	3.52E-11	NA	NA	NA	NA	NE	NA	3.52E-11
Zinc	2.68E-08	NA	NA	NA	NA	1.06E-10	NA	2.69E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	7.77E-06	NA	NA	NA	NA	NA	NA	7.77E-06
Hydrogen Chloride	7.77E-06	NA	NA	NA	NA	NA	NA	7.77E-06
Hydrogen Fluorides	2.74E-07	NA	NA	NA	NA	NA	NA	2.74E-07
Nitric Acid	6.40E-06	NA	NA	NA	NA	NA	NA	6.40E-06
Nitrogen Dioxide	5.30E-05	NA	NA	NA	NA	NA	NA	5.30E-05
Particulate Matter	2.29E-05	NA	NA	NA	NA	NA	NA	2.29E-05
Sulfur Dioxide	4.02E-05	NA	NA	NA	NA	NA	NA	4.02E-05
Sulfuric Acid Mist	1.69E-05	NA	NA	NA	NA	NA	NA	1.69E-05

NA = Not applicable
NE = Not evaluted

Table 8-8

Maximum Total Pollutant Daily Intake for the Adult, Farmer Scenario

	Daily Intake (mg/kg/day)							
Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	1.77E-17	NA	NA	NA	NA	NA	NA	1.77E-17
Acetonitrile	1.07E-15	1.29E-14	1.00E-20	3.90E-21	1.41E-18	8.42E-22	3.37E-19	1.40E-14
Acrylonitrile	1.07E-16	NA	NA	NA	NA	NA	NA	1.07E-16
Aldrin	1.14E-17	4.91E-17	5.20E-17	5.88E-18	1.50E-20	2.08E-22	3.57E-21	1.18E-16
Atrazine	2.53E-18	4.37E-19	3.65E-22	8.17E-23	1.12E-21	0.00E+00	2.67E-22	2.97E-18
Benzaldehyde	2.33E-13	9.39E-14	1.38E-17	5.05E-18	3.07E-16	2.31E-17	7.31E-17	3.27E-13
Benzene	2.30E-13	NA	NA	NA	NA	NA	NA	2.30E-13
Benzofuran	4.48E-13	1.96E-13	1.14E-16	3.40E-17	5.89E-16	1.99E-16	1.40E-16	6.45E-13
Benzoic Acid	1.13E-13	3.45E-14	1.03E-17	3.63E-18	1.49E-16	2.01E-17	3.54E-17	1.48E-13
Benzonitrile	1.07E-16	4.06E-17	6.93E-21	2.52E-21	1.41E-19	1.18E-20	3.37E-20	1.48E-16
Biphenyl	1.12E-13	NA	NA	NA	NA	NA	NA	1.12E-13
Bromomethane	2.24E-14	NA	NA	NA	NA	NA	NA	2.24E-14
Carbazole	2.15E-17	6.58E-18	1.42E-20	3.45E-21	2.83E-20	1.27E-20	6.74E-21	2.81E-17
Carbon Tetrachloride	7.13E-17	NA	NA	NA	NA	NA	NA	7.13E-17
Chlorobenzene	5.53E-14	NA	NA	NA	NA	NA	NA	5.53E-14
4-Chlorobiphenyl	1.30E-13	2.19E-14	2.06E-15	2.84E-16	1.71E-16	5.60E-17	4.07E-17	1.54E-13
4,4-Chlorobiphenyl	1.70E-15	2.35E-16	1.22E-16	1.50E-17	2.24E-18	2.45E-19	5.33E-19	2.08E-15
Chloroform	1.13E-17	NA	NA	NA	NA	NA	NA	1.13E-17
4-Chlorophenylmethylsulfone	4.15E-17	1.14E-17	1.03E-21	3.72E-22	2.94E-20	2.95E-21	7.02E-21	5.30E-17
4-Chlorophenylmethylsulfoxide	1.55E-16	4.47E-17	4.46E-21	1.58E-21	1.09E-19	1.09E-20	2.61E-20	1.99E-16
p,p-DDE	1.89E-14	8.40E-16	1.74E-15	2.10E-16	2.30E-17	6.36E-16	5.48E-18	2.24E-14
p,p-DDT	3.79E-18	1.09E-18	1.60E-18	1.85E-19	4.60E-21	1.33E-19	1.10E-21	6.80E-18
Dibenzofuran	2.24E-14	4.87E-15	6.89E-17	1.20E-17	2.94E-17	1.97E-17	7.01E-18	2.74E-14
Dichlorobenzenes (total)	4.03E-17	NA	NA	NA	NA	NA	NA	4.03E-17
1,4-Dichlorobenzene	2.55E-18	NA	NA	NA	NA	NA	NA	2.55E-18
1,1-Dichloroethene	6.26E-17	NA	NA	NA	NA	NA	NA	6.26E-17
1,2-Dichloroethene	4.36E-17	NA	NA	NA	NA	NA	NA	4.36E-17
1,2-Dichloropropane	5.07E-18	NA	NA	NA	NA	NA	NA	5.07E-18
Dieldrin	2.34E-18	6.73E-17	6.84E-19	8.00E-20	3.07E-21	8.91E-21	7.33E-22	7.04E-17
Diisopropyl Methylphosphonate	4.11E-16	1.03E-16	2.41E-20	8.35E-21	3.88E-19	5.61E-20	9.25E-20	5.14E-16
1,3-Dimethylbenzene	4.48E-14	1.43E-14	2.55E-17	6.41E-18	5.89E-17	2.58E-17	1.40E-17	5.92E-14
Dimethyldisulfide	1.14E-15	NA	NA	NA	NA	NA	NA	1.14E-15
Dimethyl Methylphosphonate	9.78E-15	5.57E-15	5.07E-22	1.92E-22	3.06E-19	3.07E-19	7.30E-20	1.54E-14
Dimethylphosphate	2.68E-15	1.07E-16	NE	NE	3.53E-18	NE	8.42E-19	2.79E-15
Dioxins/Furans (EPA TEFs)	6.86E-15	3.55E-16	1.25E-15	5.11E-16	8.49E-18	2.24E-17	2.02E-18	9.01E-15
Dithiane	4.11E-19	3.35E-19	1.15E-23	4.40E-24	5.40E-22	1.49E-23	1.29E-22	7.47E-19
Endrin	2.27E-18	9.62E-20	1.72E-20	2.55E-21	2.78E-21	1.26E-21	6.63E-22	2.39E-18
Ethylbenzene	6.72E-14	NA	NA	NA	NA	NA	NA	6.72E-14
Hexachlorobenzene	7.63E-16	2.13E-16	4.26E-17	5.26E-18	8.94E-19	4.41E-18	2.13E-19	1.03E-15
Hexachlorocyclopentadiene	2.12E-17	6.44E-17	1.30E-18	1.61E-19	2.78E-20	6.95E-21	6.64E-21	8.70E-17
Isodrin	5.99E-18	8.77E-17	3.56E-18	4.10E-19	7.88E-21	2.04E-19	1.88E-21	9.79E-17
Malathion	9.14E-18	1.38E-18	3.20E-21	8.96E-22	1.20E-20	0.00E+00	2.87E-21	1.05E-17
Methanol	2.60E-13	1.49E-12	1.51E-18	5.91E-19	3.42E-16	9.50E-18	8.15E-17	1.75E-12

Table 8-8
(continued)

Methyl Chloride	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Methylene Chloride	2.24E-14	NA	NA	NA	NA	NA	NA	2.24E-14
4-Nitrophenol	9.46E-17	3.55E-17	3.42E-20	9.50E-21	1.25E-19	4.89E-20	2.97E-20	1.30E-16
PAHs								
Acenaphthalene	1.12E-13	5.61E-14	3.12E-16	5.56E-17	1.47E-16	9.49E-17	3.51E-17	1.69E-13
Acenaphthene	1.12E-13	2.65E-14	2.33E-16	4.39E-17	1.47E-16	3.68E-17	3.51E-17	1.39E-13
Benzo(a)pyrene	2.24E-14	1.03E-15	1.07E-14	1.22E-15	1.44E-17	1.26E-17	3.43E-18	3.54E-14
Chrysene	2.24E-14	2.36E-15	2.54E-15	2.97E-16	1.63E-17	3.19E-16	3.90E-18	2.79E-14
Dibenzo(a,h)anthracene	2.24E-14	1.22E-15	1.29E-14	1.47E-15	1.70E-17	7.16E-15	4.06E-18	4.51E-14
Fluoranthene	6.72E-14	1.11E-14	2.10E-15	2.56E-16	4.85E-17	NA	1.16E-17	8.07E-14
Fluorene	2.24E-14	6.96E-15	1.17E-16	1.87E-17	2.94E-17	2.64E-17	7.01E-18	2.95E-14
Phenanthrene	4.48E-14	5.74E-15	3.23E-16	4.22E-17	2.63E-17	8.86E-17	6.28E-18	5.10E-14
Pyrene	2.24E-14	2.97E-15	6.33E-16	7.61E-17	1.29E-17	7.27E-17	3.07E-18	2.61E-14
Parathion	1.26E-18	3.09E-19	2.12E-21	4.18E-22	1.66E-21	6.54E-22	3.96E-22	1.58E-18
Pentachlorobenzene	3.41E-16	1.91E-16	8.04E-18	1.07E-18	4.49E-19	NA	1.07E-19	5.42E-16
Phenol	1.21E-12	3.10E-12	7.01E-17	2.57E-17	1.59E-15	2.10E-17	3.80E-16	4.32E-12
Pyridine	1.07E-17	NA	NA	NA	NA	NA	NA	1.07E-17
Quinoline	5.35E-17	4.12E-17	5.92E-21	2.03E-21	7.04E-20	1.22E-20	1.68E-20	9.48E-17
Styrene	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Supona	3.79E-18	9.43E-19	1.87E-21	4.85E-22	4.99E-21	2.13E-21	1.19E-21	4.74E-18
Tetrachlorobenzene	1.44E-16	1.80E-16	7.39E-19	1.18E-19	1.89E-19	NA	4.52E-20	3.25E-16
Tetrachloroethene	8.91E-16	NA	NA	NA	NA	NA	NA	8.91E-16
Toluene	1.12E-13	NA	NA	NA	NA	NA	NA	1.12E-13
Trichlorobenzene	7.59E-17	1.15E-17	1.77E-19	3.26E-20	9.98E-20	9.56E-20	2.38E-20	8.78E-17
Trichloroethene	1.37E-16	NA	NA	NA	NA	NA	NA	1.37E-16
Urea	1.64E-12	1.52E-10	1.19E-18	4.67E-19	2.16E-15	6.01E-17	5.15E-16	1.53E-10
Vapona	1.01E-17	4.35E-18	5.48E-22	2.02E-22	1.33E-20	8.82E-22	3.17E-21	1.45E-17
Vinyl Chloride	2.24E-13	NA	NA	NA	NA	NA	NA	2.24E-13
Xylene	4.48E-14	NA	NA	NA	NA	NA	NA	4.48E-14
INORGANICS								
Aluminum	2.97E-08	NA	NA	NA	NA	NE	NA	2.97E-08
Ammonia	5.35E-09	NA	NA	NA	NA	NA	NA	5.35E-09
Antimony	1.04E-09	4.43E-11	2.43E-12	9.96E-13	1.37E-12	NA	3.27E-14	1.09E-09
Arsenic	5.90E-09	2.38E-10	9.12E-10	1.12E-11	7.76E-12	1.49E-11	1.85E-13	7.08E-09
Barium	1.44E-09	5.97E-11	1.22E-11	2.01E-13	1.90E-12	NE	4.53E-14	1.52E-09
Beryllium	6.03E-11	2.41E-12	1.22E-15	4.94E-14	7.94E-14	7.67E-15	1.89E-15	6.29E-11
Boron	4.40E-08	NA	NA	NA	NA	NE	NA	4.40E-08
Cadmium	1.72E-10	NA	NA	NA	NA	3.78E-13	NA	1.72E-10
Calcium	2.53E-07	NA	NA	NA	NA	NA	NA	2.53E-07
Chromium (III)	3.92E-10	NA	NA	NA	NA	NA	NA	3.92E-10
Chromium (VI)	1.38E-11	NA	NA	NA	NA	1.43E-14	NA	1.38E-11
Cobalt	1.30E-09	NA	NA	NA	NA	1.74E-13	NA	1.30E-09
Copper	5.53E-06	3.23E-07	2.58E-07	9.69E-08	7.28E-09	4.48E-08	1.74E-10	6.26E-06
Cyanogen	1.07E-17	NA	NA	NA	NA	NA	NA	1.07E-17
Hydrogen Cyanide	1.06E-13	NA	NA	NA	NA	NA	NA	1.06E-13
Iron	7.86E-08	NA	NA	NA	NA	NE	NA	7.86E-08
Lead	1.85E-09	7.51E-11	1.11E-11	5.33E-13	2.44E-12	2.28E-12	5.81E-14	1.94E-09
Lithium	1.81E-10	NA	NA	NA	NA	NE	NA	1.81E-10
Magnesium	2.35E-07	NA	NA	NA	NA	NE	NA	2.35E-07

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Table 8-8
(continued)

Manganese	1.01E-08	NA	NA	NA	NA	NA	NA	1.01E-08
Mercury	1.63E-09	9.26E-11	2.15E-11	7.33E-10	2.15E-12	NA	5.12E-14	2.48E-09
Molybdenum	1.81E-08	NA	NA	NA	NA	NE	NA	1.81E-08
Nickel	4.71E-08	NA	NA	NA	NA	NA	NA	4.71E-08
Phosphate	5.49E-06	NA	NA	NA	NA	NA	NA	5.49E-06
Potassium	1.87E-06	NA	NA	NA	NA	NA	NA	1.87E-06
Selenium	1.51E-05	6.29E-07	1.58E-06	2.36E-07	1.99E-08	1.75E-09	4.75E-10	1.76E-05
Silicon	2.61E-07	NA	NA	NA	NA	NA	NA	2.61E-07
Silver	1.57E-07	7.54E-09	9.01E-08	6.63E-10	2.06E-10	3.46E-09	4.92E-12	2.59E-07
Sodium	1.92E-04	NA	NA	NA	NA	NA	NA	1.92E-04
Strontium	6.03E-11	NA	NA	NA	NA	NE	NA	6.03E-11
Thallium	1.52E-08	6.06E-10	6.81E-10	4.95E-10	2.00E-11	NA	4.78E-13	1.70E-08
Tin	1.33E-08	NA	NA	NA	NA	NE	NA	1.33E-08
Titanium	1.01E-10	NA	NA	NA	NA	NE	NA	1.01E-10
Vanadium	3.85E-09	NA	NA	NA	NA	2.58E-13	NA	3.85E-09
Yittrium	3.52E-11	NA	NA	NA	NA	NE	NA	3.52E-11
Zinc	2.68E-08	NA	NA	NA	NA	1.06E-10	NA	2.69E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	7.77E-06	NA	NA	NA	NA	NA	NA	7.77E-06
Hydrogen Chloride	7.77E-06	NA	NA	NA	NA	NA	NA	7.77E-06
Hydrogen Fluorides	2.74E-07	NA	NA	NA	NA	NA	NA	2.74E-07
Nitric Acid	6.40E-06	NA	NA	NA	NA	NA	NA	6.40E-06
Nitrogen Dioxide	5.30E-05	NA	NA	NA	NA	NA	NA	5.30E-05
Particulate Matter	2.29E-05	NA	NA	NA	NA	NA	NA	2.29E-05
Sulfur Dioxide	4.02E-05	NA	NA	NA	NA	NA	NA	4.02E-05
Sulfuric Acid Mist	1.69E-05	NA	NA	NA	NA	NA	NA	1.69E-05

NA = Not applicable
NE = Not evaluted

Table 8-9

Average Total Pollutant Daily Intake for the Adult, Worker Scenario

	Daily Intake (mg/kg/day)			
Pollutant	Inhalation	Soil/Dust Ingestion	Dermal Absorption	Total
ORGANICS				
Acetone	5.07E-18	NA	NA	5.07E-18
Acetonitrile	3.08E-16	6.57E-19	5.08E-19	3.09E-16
Acrylonitrile	3.08E-17	NA	NA	3.08E-17
Aldrin	3.26E-18	6.96E-21	5.39E-21	3.28E-18
Atrazine	7.25E-19	1.61E-23	1.24E-23	7.25E-19
Benzaldehyde	6.69E-14	1.43E-16	1.10E-16	6.71E-14
Benzene	6.60E-14	NA	NA	6.60E-14
Benzofuran	1.28E-13	2.74E-16	2.12E-16	1.29E-13
Benzoic Acid	3.24E-14	6.91E-17	5.34E-17	3.25E-14
Benzonitrile	3.08E-17	6.57E-20	5.08E-20	3.09E-17
Biphenyl	3.21E-14	NA	NA	3.21E-14
Bromomethane	6.42E-15	NA	NA	6.42E-15
Carbazole	6.16E-18	1.31E-20	1.02E-20	6.19E-18
Carbon Tetrachloride	2.05E-17	NA	NA	2.05E-17
Chlorobenzene	1.59E-14	NA	NA	1.59E-14
4-Chlorobiphenyl	3.72E-14	7.94E-17	6.14E-17	3.74E-14
4,4-Chlorobiphenyl	4.88E-16	1.04E-18	8.05E-19	4.90E-16
Chloroform	3.24E-18	NA	NA	3.24E-18
4-Chlorophenylmethylsulfone	1.19E-17	5.28E-22	4.09E-22	1.19E-17
4-Chlorophenylmethylsulfoxide	4.43E-17	1.97E-21	1.52E-21	4.43E-17
p,p-DDE	5.43E-15	2.16E-18	1.67E-18	5.43E-15
p,p-DDT	1.09E-18	4.32E-22	3.35E-22	1.09E-18
Dibenzofuran	6.41E-15	1.37E-17	1.06E-17	6.44E-15
Dichlorobenzenes (total)	1.16E-17	NA	NA	1.16E-17
1,4-Dichlorobenzene	7.30E-19	NA	NA	7.30E-19
1,1-Dichloroethene	1.80E-17	NA	NA	1.80E-17
1,2-Dichloroethene	1.25E-17	NA	NA	1.25E-17
1,2-Dichloropropane	1.46E-18	NA	NA	1.46E-18
Dieldrin	6.70E-19	1.43E-21	1.11E-21	6.73E-19
Diisopropyl Methylphosphonate	1.18E-16	1.05E-20	8.09E-21	1.18E-16
1,3-Dimethylbenzene	1.28E-14	2.74E-17	2.12E-17	1.29E-14
Dimethyldisulfide	3.26E-16	NA	NA	3.26E-16
Dimethyl Methylphosphonate	2.81E-15	4.12E-21	3.19E-21	2.81E-15
Dimethylphosphate	7.70E-16	1.64E-18	1.27E-18	7.73E-16
Dioxins/Furans (EPA TEFs)	1.97E-15	1.03E-18	7.96E-19	1.97E-15
Dithiane	1.18E-19	2.51E-22	1.94E-22	1.18E-19
Endrin	6.52E-19	2.87E-22	2.22E-22	6.52E-19
Ethylbenzene	1.93E-14	NA	NA	1.93E-14
Hexachlorobenzene	2.19E-16	5.83E-20	4.51E-20	2.19E-16
Hexachlorocyclopentadiene	6.07E-18	1.29E-20	1.00E-20	6.09E-18
Isodrin	1.72E-18	3.66E-21	2.83E-21	1.72E-18
Malathion	2.62E-18	5.59E-21	4.33E-21	2.63E-18
Methanol	7.45E-14	1.59E-16	1.23E-16	7.48E-14
Methyl Chloride	6.42E-14	NA	NA	6.42E-14
Methylene Chloride	6.42E-15	NA	NA	6.42E-15
4-Nitrophenol	2.71E-17	5.79E-20	4.48E-20	2.72E-17
PAHs				
Acenaphthalene	3.21E-14	6.85E-17	5.30E-17	3.22E-14
Acenaphthene	3.21E-14	6.85E-17	5.30E-17	3.22E-14
Benzo(a)pyrene	6.41E-15	2.41E-19	1.86E-19	6.41E-15
Chrysene	6.41E-15	3.02E-19	2.34E-19	6.41E-15
Dibenzo(a,h)anthracene	6.41E-15	3.28E-19	2.53E-19	6.41E-15
Fluoranthene	1.93E-14	8.84E-19	6.83E-19	1.93E-14
Fluorene	6.41E-15	1.37E-17	1.06E-17	6.44E-15
Phenanthrene	1.28E-14	4.18E-19	3.23E-19	1.28E-14
Pyrene	6.41E-15	2.03E-19	1.57E-19	6.41E-15
Parathion	3.62E-19	7.72E-22	5.97E-22	3.63E-19
Pentachlorobenzene	9.79E-17	2.09E-19	1.62E-19	9.83E-17
Phenol	3.47E-13	7.41E-16	5.73E-16	3.49E-13
Pyridine	3.08E-18	NA	NA	3.08E-18
Quinoline	1.53E-17	3.27E-20	2.53E-20	1.54E-17

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Table 8-9
(continued)

Styrene	6.44E-14	NA	NA	6.44E-14
Supona	1.09E-18	2.32E-21	1.79E-21	1.09E-18
Tetrachlorobenzene	4.13E-17	8.81E-20	6.81E-20	4.15E-17
Tetrachloroethene	2.56E-16	NA	NA	2.56E-16
Toluene	3.21E-14	NA	NA	3.21E-14
Trichlorobenzene	2.18E-17	4.64E-20	3.59E-20	2.18E-17
Trichloroethene	3.93E-17	NA	NA	3.93E-17
Urea	4.71E-13	1.00E-15	7.76E-16	4.72E-13
Vapona	2.90E-18	6.18E-21	4.78E-21	2.91E-18
Vinyl Chloride	6.42E-14	NA	NA	6.42E-14
Xylene	1.28E-14	NA	NA	1.28E-14
INORGANICS				
Aluminum	8.51E-09	NA	NA	8.51E-09
Ammonia	1.53E-09	NA	NA	1.53E-09
Antimony	2.99E-10	6.37E-13	4.93E-14	3.00E-10
Arsenic	1.69E-09	3.61E-12	2.79E-13	1.70E-09
Barium	4.14E-10	8.84E-13	6.83E-14	4.15E-10
Beryllium	1.73E-11	3.69E-14	2.85E-15	1.73E-11
Boron	1.26E-08	NA	NA	1.26E-08
Cadmium	4.93E-11	NA	NA	4.93E-11
Calcium	7.25E-08	NA	NA	7.25E-08
Chromium (III)	1.12E-10	NA	NA	1.12E-10
Chromium (VI)	3.96E-12	NA	NA	3.96E-12
Cobalt	3.72E-10	NA	NA	3.72E-10
Copper	1.59E-06	3.38E-09	2.62E-10	1.59E-06
Cyanogen	3.08E-18	NA	NA	3.08E-18
Hydrogen Cyanide	3.04E-14	NA	NA	3.04E-14
Iron	2.26E-08	NA	NA	2.26E-08
Lead	5.31E-10	1.13E-12	8.76E-14	5.32E-10
Lithium	5.19E-11	NA	NA	5.19E-11
Magnesium	6.74E-08	NA	NA	6.74E-08
Manganese	2.91E-09	NA	NA	2.91E-09
Mercury	4.68E-10	9.98E-13	7.72E-14	4.69E-10
Molybdenum	5.21E-09	NA	NA	5.21E-09
Nickel	1.35E-08	NA	NA	1.35E-08
Phosphate	1.57E-06	NA	NA	1.57E-06
Potassium	5.36E-07	NA	NA	5.36E-07
Selenium	4.34E-06	9.25E-09	7.16E-10	4.35E-06
Silicon	7.47E-08	NA	NA	7.47E-08
Silver	4.50E-08	9.59E-11	7.42E-12	4.51E-08
Sodium	5.52E-05	NA	NA	5.52E-05
Strontium	1.73E-11	NA	NA	1.73E-11
Thallium	4.37E-09	9.31E-12	7.20E-13	4.38E-09
Tin	3.82E-09	NA	NA	3.82E-09
Titanium	2.88E-11	NA	NA	2.88E-11
Vanadium	1.10E-09	NA	NA	1.10E-09
Yittrium	1.01E-11	NA	NA	1.01E-11
Zinc	7.68E-09	NA	NA	7.68E-09
CRITERIA POLLUTANTS/ ACID GASES				
Carbon Monoxide	2.23E-06	NA	NA	2.23E-06
Hydrogen Chloride	2.23E-06	NA	NA	2.23E-06
Hydrogen Fluorides	7.87E-08	NA	NA	7.87E-08
Nitric Acid	1.84E-06	NA	NA	1.84E-06
Nitrogen Dioxide	1.52E-05	NA	NA	1.52E-05
Particulate Matter	6.56E-06	NA	NA	6.56E-06
Sulfur Dioxide	1.15E-05	NA	NA	1.15E-05
Sulfuric Acid Mist	4.85E-06	NA	NA	4.85E-06

NA = Not applicable
NE = Not evaluted

DRAFT

Table 8-10

Maximum Total Pollutant Daily Intake for the Adult, Worker Scenario

Pollutant	Inhalation	Soil/Dust Ingestion	Dermal Absorption	Total
	Daily Intake (mg/kg/day)			
ORGANICS				
Acetone	5.07E-18	NA	NA	5.07E-18
Acetonitrile	3.08E-16	6.67E-19	5.16E-19	3.09E-16
Acrylonitrile	3.08E-17	NA	NA	3.08E-17
Aldrin	3.26E-18	7.06E-21	5.46E-21	3.28E-18
Atrazine	7.25E-19	5.27E-22	4.08E-22	7.26E-19
Benzaldehyde	6.69E-14	1.45E-16	1.12E-16	6.71E-14
Benzene	6.60E-14	NA	NA	6.60E-14
Benzofuran	1.28E-13	2.78E-16	2.15E-16	1.29E-13
Benzoic Acid	3.24E-14	7.01E-17	5.42E-17	3.25E-14
Benzonitrile	3.08E-17	6.67E-20	5.16E-20	3.09E-17
Biphenyl	3.21E-14	NA	NA	3.21E-14
Bromomethane	6.42E-15	NA	NA	6.42E-15
Carbazole	6.16E-18	1.33E-20	1.03E-20	6.19E-18
Carbon Tetrachloride	2.05E-17	NA	NA	2.05E-17
Chlorobenzene	1.59E-14	NA	NA	1.59E-14
4-Chlorobiphenyl	3.72E-14	8.06E-17	6.23E-17	3.74E-14
4,4-Chlorobiphenyl	4.88E-16	1.06E-18	8.16E-19	4.90E-16
Chloroform	3.24E-18	NA	NA	3.24E-18
4-Chlorophenylmethylsulfone	1.19E-17	1.39E-20	1.07E-20	1.19E-17
4-Chlorophenylmethylsulfoxide	4.43E-17	5.16E-20	3.99E-20	4.44E-17
p,p-DDE	5.43E-15	1.08E-17	8.39E-18	5.45E-15
p,p-DDT	1.09E-18	2.17E-21	1.68E-21	1.09E-18
Dibenzofuran	6.41E-15	1.39E-17	1.07E-17	6.44E-15
Dichlorobenzenes (total)	1.16E-17	NA	NA	1.16E-17
1,4-Dichlorobenzene	7.30E-19	NA	NA	7.30E-19
1,1-Dichloroethene	1.80E-17	NA	NA	1.80E-17
1,2-Dichloroethene	1.25E-17	NA	NA	1.25E-17
1,2-Dichloropropane	1.46E-18	NA	NA	1.46E-18
Dieldrin	6.70E-19	1.45E-21	1.12E-21	6.73E-19
Diisopropyl Methylphosphonate	1.18E-16	1.83E-19	1.42E-19	1.18E-16
1,3-Dimethylbenzene	1.28E-14	2.78E-17	2.15E-17	1.29E-14
Dimethyldisulfide	3.26E-16	NA	NA	3.26E-16
Dimethyl Methylphosphonate	2.81E-15	1.44E-19	1.12E-19	2.81E-15
Dimethylphosphate	7.70E-16	1.67E-18	1.29E-18	7.73E-16
Dioxins/Furans (EPA TEFs)	1.97E-15	4.00E-18	3.10E-18	1.97E-15
Dithiane	1.18E-19	2.55E-22	1.97E-22	1.18E-19
Endrin	6.52E-19	1.31E-21	1.01E-21	6.54E-19
Ethylbenzene	1.93E-14	NA	NA	1.93E-14
Hexachlorobenzene	2.19E-16	4.21E-19	3.26E-19	2.20E-16
Hexachlorocyclopentadiene	6.07E-18	1.31E-20	1.02E-20	6.09E-18
Isodrin	1.72E-18	3.72E-21	2.87E-21	1.72E-18
Malathion	2.62E-18	5.67E-21	4.39E-21	2.63E-18
Methanol	7.45E-14	1.61E-16	1.25E-16	7.48E-14
Methyl Chloride	6.42E-14	NA	NA	6.42E-14
Methylene Chloride	6.42E-15	NA	NA	6.42E-15
4-Nitrophenol	2.71E-17	5.87E-20	4.54E-20	2.72E-17
PAHs				
Acenaphthalene	3.21E-14	6.95E-17	5.38E-17	3.22E-14
Acenaphthene	3.21E-14	6.95E-17	5.38E-17	3.22E-14
Benzo(a)pyrene	6.41E-15	6.79E-18	5.25E-18	6.42E-15
Chrysene	6.41E-15	7.71E-18	5.96E-18	6.43E-15
Dibenzo(a,h)anthracene	6.41E-15	8.03E-18	6.21E-18	6.43E-15
Fluoranthene	1.93E-14	2.28E-17	1.77E-17	1.93E-14
Fluorene	6.41E-15	1.39E-17	1.07E-17	6.44E-15
Phenanthrene	1.28E-14	1.24E-17	9.61E-18	1.29E-14
Pyrene	6.41E-15	6.08E-18	4.70E-18	6.42E-15
Parathion	3.62E-19	7.83E-22	6.06E-22	3.63E-19
Pentachlorobenzene	9.79E-17	2.12E-19	1.64E-19	9.83E-17
Phenol	3.47E-13	7.52E-16	5.81E-16	3.49E-13
Pyridine	3.08E-18	NA	NA	3.08E-18
Quinoline	1.53E-17	3.32E-20	2.57E-20	1.54E-17
Styrene	6.44E-14	NA	NA	6.44E-14

Table 8-10
(continued)

Supona	1.09E-18	2.35E-21	1.82E-21	1.09E-18
Tetrachlorobenzene	4.13E-17	8.94E-20	6.91E-20	4.15E-17
Tetrachloroethene	2.56E-16	NA	NA	2.56E-16
Toluene	3.21E-14	NA	NA	3.21E-14
Trichlorobenzene	2.18E-17	4.71E-20	3.64E-20	2.18E-17
Trichloroethene	3.93E-17	NA	NA	3.93E-17
Urea	4.71E-13	1.02E-15	7.88E-16	4.73E-13
Vapona	2.90E-18	6.27E-21	4.85E-21	2.91E-18
Vinyl Chloride	6.42E-14	NA	NA	6.42E-14
Xylene	1.28E-14	NA	NA	1.28E-14
INORGANICS				
Aluminum	8.51E-09	NA	NA	8.51E-09
Ammonia	1.53E-09	NA	NA	1.53E-09
Antimony	2.99E-10	6.47E-13	5.00E-14	3.00E-10
Arsenic	1.69E-09	3.66E-12	2.83E-13	1.70E-09
Barium	4.14E-10	8.96E-13	6.93E-14	4.15E-10
Beryllium	1.73E-11	3.74E-14	2.90E-15	1.73E-11
Boron	1.26E-08	NA	NA	1.26E-08
Cadmium	4.93E-11	NA	NA	4.93E-11
Calcium	7.25E-08	NA	NA	7.25E-08
Chromium (III)	1.12E-10	NA	NA	1.12E-10
Chromium (VI)	3.96E-12	NA	NA	3.96E-12
Cobalt	3.72E-10	NA	NA	3.72E-10
Copper	1.59E-06	3.43E-09	2.65E-10	1.59E-06
Cyanogen	3.08E-18	NA	NA	3.08E-18
Hydrogen Cyanide	3.04E-14	NA	NA	3.04E-14
Iron	2.26E-08	NA	NA	2.26E-08
Lead	5.31E-10	1.15E-12	8.89E-14	5.32E-10
Lithium	5.19E-11	NA	NA	5.19E-11
Magnesium	6.74E-08	NA	NA	6.74E-08
Manganese	2.91E-09	NA	NA	2.91E-09
Mercury	4.68E-10	1.01E-12	7.83E-14	4.69E-10
Molybdenum	5.21E-09	NA	NA	5.21E-09
Nickel	1.35E-08	NA	NA	1.35E-08
Phosphate	1.57E-06	NA	NA	1.57E-06
Potassium	5.36E-07	NA	NA	5.36E-07
Selenium	4.34E-06	9.39E-09	7.26E-10	4.35E-06
Silicon	7.47E-08	NA	NA	7.47E-08
Silver	4.50E-08	9.73E-11	7.53E-12	4.51E-08
Sodium	5.52E-05	NA	NA	5.52E-05
Strontium	1.73E-11	NA	NA	1.73E-11
Thallium	4.37E-09	9.45E-12	7.31E-13	4.38E-09
Tin	3.82E-09	NA	NA	3.82E-09
Titanium	2.88E-11	NA	NA	2.88E-11
Vanadium	1.10E-09	NA	NA	1.10E-09
Yittrium	1.01E-11	NA	NA	1.01E-11
Zinc	7.68E-09	NA	NA	7.68E-09
CRITERIA POLLUTANTS/ ACID GASES				
Carbon Monoxide	2.23E-06	NA	NA	2.23E-06
Hydrogen Chloride	2.23E-06	NA	NA	2.23E-06
Hydrogen Fluorides	7.87E-08	NA	NA	7.87E-08
Nitric Acid	1.84E-06	NA	NA	1.84E-06
Nitrogen Dioxide	1.52E-05	NA	NA	1.52E-05
Particulate Matter	6.56E-06	NA	NA	6.56E-06
Sulfur Dioxide	1.15E-05	NA	NA	1.15E-05
Sulfuric Acid Mist	4.85E-06	NA	NA	4.85E-06

NA = Not applicable
NE = Not evaluted

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Table 8-11

Exposure Parameters Used for Adult, Child, and Infant for the Various Scenarios

Pathways and Parameters	Worker Scenario	Farmer Scenario -Adult	Farmer Scenario -Child	Resident-A and Resident-B Scenarios -Adult	Resident-A and Resident-B Scenarios -Child	Resident-A and -B and Farmer Scenarios -Infant
AIR PATHWAY						
• Breathing rate	10 m^3/day (U.S. Army PMO, 1990a)	20 m^3/day (U.S.Army PMO, 1990b)	10 m^3/day (U.S. NRC, 1977)	20 m^3/day (U.S. Army PMO, 1990b)	10 m^3/day (U.S. NRC, 1977)	3.8 m^3/day (NCRP, 1984)
• Exposure frequency	250 days/yr[a]	365 days/yr	365 days/yr	365 days/yr	365 days/yr	365 days/yr
SOIL PATHWAY						
• Soil/dust ingestion rate	50 mg/day (U.S. Army PMO, 1990a)	100 mg/day (EPA, 1990b)	200 mg/day (EPA, 1990b)	100 mg/day (EPA, 1990b)	200 mg/day (EPA, 1990b)	---
• Exposure frequency for soil ingestion	225 days/yr[b]	365 days/yr	365 days/yr	365 days/yr	365 days/yr	---
• Skin surface area	1,700 cm^2[c] (U.S. Army PMO, 1990a)	1,700 cm^2[c] (U.S. Army PMO, 1990a)	2,188 cm^2[d] (EPA, 1989)	1,700 cm^2[c] (U.S. Army PMO, 1990a)	2,188 cm^2[d] (EPA, 1989)	---
• Soil adherence factor	3.5 mg/cm^2 (U.S. Army PMO, 1990a)	3.5 mg/cm^2 (U.S. Army PMO, 1990a)	0.51 mg/cm^2 (U.S. Army PMO, 1990a)	0.51 mg/cm^2 (U.S. Army PMO, 1990a)	0.51 mg/cm^2 (U.S. Army PMO, 1990a)	--

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Table 8-11
(continued)

Pathways and Parameters	Worker Scenario	Farmer Scenario -Adult	Farmer Scenario -Child	Resident-A and Resident-B Scenarios -Adult	Resident-A and Resident-B Scenarios -Child	Resident-A and -B and Farmer Scenarios -Infant
SOIL PATHWAY						
• Soil matrix factor	0.15 (U.S. Army PMO, 1990a)	0.15 (U.S. Army PMO, 1990a)	0.15 (U.S. Army PMO, 1990a)	0.15 (U.S. Army PMO, 1990a)	0.15 (U.S. Army PMO, 1990a)	---
• Dermal absorption	0.01 (metals) 0.10 (organics) (U.S. Army PMO, 1990a)	0.01 (metals) 0.10 (organics) (U.S. Army PMO, 1990a)	0.01 (metals) 0.10 (organics) (U.S. Army PMO, 1990a)	0.01 (metals) 0.10 (organics) (U.S. Army PMO, 1990a)	0.01 (metals) 0.10 (organics) (U.S. Army PMO, 1990a)	---
• Exposure frequency for dermal contact	195 days/yr[e]	195 days/yr[e]	195 days/yr[e]	117 days/yr[f]	195 days/yr[f]	---
• Vegetable Ingestion rate -Root -Fruiting -Leafy	 --- --- ---	65.3 g/day[g] 64 g/day 11.9 g/day (EPA, 1990a)	31.1 g/day[g] 33.6 g/day 1.24 g/day (EPA, 1990a)	11.7 g/day[h] 64 g/day 11.9 g/day (EPA, 1990a)	3.88 g/day[h] 33.6 g/day 1.24 g/day (EPA, 1990a)	---
• Percent Vegetables home-grown	---	90% (EPA, 1990b)	90% (EPA, 1990b)	58% (U.S. Army PMO, 1989)	58% (U.S. Army PMO, 1989)	---

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Table 8-11
(continued)

Pathways and Parameters	Worker Scenario	Farmer Scenario -Adult	Farmer Scenario -Child	Resident-A and Resident-B Scenarios -Adult	Resident-A and Resident-B Scenarios -Child	Resident-A and -B and Farmer Scenarios -Infant
SOIL PATHWAY						
• Milk ingestion rate	---	305 g/day (Fries, 1986)	390 g/day (Pao et al., 1982)	305 g/day (Fries, 1986)	390 g/day (Pao et al., 1982)	800 g/day (Smith, 1987)
• Milk fat ingestion rate	---	11 g/day (Fries, 1986)	16 g/day (EPA, 1986)	11 g/day (Fries, 1986)	16 g/day (EPA, 1986)	---
• Percent milk home or locally produced	---	100%[j]	100%[j]	5%	5%	---
• Beef ingestion rate	---	67 g/day (Fries, 1986)	37 g/day (Pao et al., 1982)	67 g/day (Fries, 1986)	37 g/day (Pao et al., 1982)	---
• Beef fat ingestion rate	---	15 g/day (Fries, 1986)	9 g/day (EPA, 1986)	15 g/day (Fries, 1986)	9 g/day (EPA, 1986)	---
• Percent beef home or locally produced	---	100%[j]	100%[j]	5%	5%	---
• Fish ingestion rate	---	4.84 g/day (U.S. Army PMO, 1989)	2.42 g/day[k]	4.84 g/day (U.S. Army PMO, 1989)	2.42 g/day[k]	---

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Table 8-11
(continued)

Pathways and Parameters	Worker Scenario	Farmer Scenario -Adult	Farmer Scenario -Child	Resident-A and Resident-B Scenarios -Adult	Resident-A and Resident-B Scenarios -Child	Resident-A and -B and Farmer Scenarios -Infant
<u>ALL PATHWAYS</u>						
• Body weight	70 kg (U.S. Army PMO, 1990a)	70 kg (U.S. Army PMO, 1990a)	15.5 kg (U.S. Army PMO, 1990a)	70 kg (U.S. Army PMO, 1990a)	15.5 kg (U.S. Army PMO, 1990a)	9 kg (EPA, 1989)

[a]Based on continuous exposure over a 5-day work week for 50 weeks out of the year.
[b]It was assumed that 90 percent of a work year (5 days/wk, 50 wks/yr) was spent outside (Don Marlow, Chief of Maintenance, Rocky Mountain Arsenal, personal communication, 1990).
[c]Based on exposed hands and forearms.
[d]Based on arms and hands exposed 50 percent of the time; and arms, hands, and legs exposed 50 percent of the time.
[e]Based on exposure for 5 days per week, 35 weeks per year. It was assumed that during the colder months, dermal exposure would be insignificant due to such factors as snow-cover, frozen ground, and greatly reduced exposed skin surface area.
[f]Based on exposure for 3 days per week, 35 weeks per year. It was assumed that during the colder months, dermal exposure would be insignificant due to such factors as snow cover, frozen ground, and greatly reduced exposed skin surface area.
[g]This root ingestion rate includes potatoes.
[h]This root ingestion rate excludes potatoes.
[i]Based on breast milk consumption.
[j]It was assumed that a subsistence farmer would consume 100 percent of home-produced milk and beef.
[k]Assumed to be one-half the adult fish ingestion rate.

Table 8-12

Average Total Pollutant Daily Intake for Child, Resident-A Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	1.14E-16	NA	NA	NA	NA	NA	NA	1.14E-16
Acetonitrile	6.91E-15	4.93E-15	2.82E-21	4.78E-22	1.47E-17	1.90E-21	6.56E-19	1.19E-14
Acrylonitrile	6.91E-16	NA	NA	NA	NA	NA	NA	6.91E-16
Aldrin	7.33E-17	9.72E-18	4.81E-19	2.97E-20	1.56E-19	4.71E-22	6.96E-21	8.36E-17
Atrazine	1.63E-17	1.30E-20	3.09E-24	3.04E-25	3.59E-22	0.00E+00	1.61E-23	1.63E-17
Benzaldehyde	1.50E-12	6.29E-14	3.57E-18	6.03E-19	3.19E-15	5.21E-17	1.42E-16	1.57E-12
Benzene	1.48E-12	NA	NA	NA	NA	NA	NA	1.48E-12
Benzofuran	2.88E-12	5.50E-14	2.19E-17	3.67E-18	6.12E-15	4.50E-16	2.73E-16	2.94E-12
Benzoic Acid	7.27E-13	1.94E-14	2.53E-18	4.26E-19	1.54E-15	4.53E-17	6.90E-17	7.48E-13
Benzonitrile	6.91E-16	2.64E-17	1.78E-21	3.00E-22	1.47E-18	2.67E-20	6.56E-20	7.19E-16
Biphenyl	7.21E-13	NA	NA	NA	NA	NA	NA	7.21E-13
Bromomethane	1.44E-13	NA	NA	NA	NA	NA	NA	1.44E-13
Carbazole	1.38E-16	1.60E-18	1.95E-21	3.23E-22	2.94E-19	2.88E-20	1.31E-20	1.40E-16
Carbon Tetrachloride	4.59E-16	NA	NA	NA	NA	NA	NA	4.59E-16
Chlorobenzene	3.56E-13	NA	NA	NA	NA	NA	NA	3.56E-13
4-Chlorobiphenyl	8.36E-13	4.10E-15	6.96E-17	9.92E-18	1.77E-15	1.26E-16	7.93E-17	8.42E-13
4,4-Chlorobiphenyl	1.09E-14	4.13E-17	2.34E-18	2.79E-19	2.32E-17	5.53E-19	1.04E-18	1.10E-14
Chloroform	7.27E-17	NA	NA	NA	NA	NA	NA	7.27E-17
4-Chlorophenylmethylsulfone	2.67E-16	4.82E-19	1.10E-23	1.75E-24	1.18E-20	6.66E-21	5.28E-22	2.68E-16
4-Chlorophenylmethylsulfoxide	9.94E-16	1.67E-18	4.74E-23	7.43E-24	4.40E-20	2.45E-20	1.97E-21	9.96E-16
p,p-DDE	1.22E-13	8.05E-17	1.70E-17	1.21E-18	4.83E-17	1.44E-15	2.16E-18	1.23E-13
p,p-DDT	2.44E-17	5.27E-20	1.42E-20	8.34E-22	9.67E-21	3.00E-19	4.32E-22	2.48E-17
Dibenzofuran	1.44E-13	1.01E-15	4.83E-18	7.64E-19	3.06E-16	4.45E-17	1.37E-17	1.45E-13
Dichlorobenzenes (total)	2.59E-16	NA	NA	NA	NA	NA	NA	2.59E-16
1,4-Dichlorobenzene	1.64E-17	NA	NA	NA	NA	NA	NA	1.64E-17
1,1-Dichloroethene	4.03E-16	NA	NA	NA	NA	NA	NA	4.03E-16
1,2-Dichloroethene	2.80E-16	NA	NA	NA	NA	NA	NA	2.80E-16
1,2-Dichloropropane	3.27E-17	NA	NA	NA	NA	NA	NA	3.27E-17
Dieldrin	1.50E-17	1.34E-17	8.96E-21	8.48E-22	3.19E-20	2.01E-20	1.43E-21	2.85E-17
Diisopropyl Methylphosphonate	2.64E-15	4.99E-18	3.65E-22	5.79E-23	2.34E-19	1.27E-19	1.04E-20	2.65E-15
1,3-Dimethylbenzene	2.88E-13	3.54E-15	3.71E-18	6.16E-19	6.12E-16	5.84E-17	2.73E-17	2.92E-13
Dimethyldisulfide	7.33E-15	NA	NA	NA	NA	NA	NA	7.33E-15
Dimethyl Methylphosphonate	6.30E-14	1.84E-16	4.18E-24	6.85E-25	9.21E-20	6.94E-19	4.12E-21	6.31E-14
Dimethylphosphate	1.73E-14	1.06E-17	NE	NE	3.67E-17	NE	1.64E-18	1.73E-14
Dioxins/Furans (EPA TEFs)	4.41E-14	3.19E-17	1.35E-17	2.98E-18	2.30E-17	5.06E-17	1.03E-18	4.43E-14
Dithiane	2.64E-18	2.70E-19	3.16E-24	5.34E-25	5.61E-21	3.36E-23	2.51E-22	2.92E-18
Endrin	1.46E-17	1.07E-20	2.64E-22	2.98E-23	6.42E-21	2.84E-21	2.87E-22	1.46E-17
Ethylbenzene	4.32E-13	NA	NA	NA	NA	NA	NA	4.32E-13
Hexachlorobenzene	4.91E-15	8.20E-18	4.06E-19	2.80E-20	1.30E-18	9.95E-18	5.83E-20	4.93E-15
Hexachlorocyclopentadiene	1.36E-16	1.27E-17	2.62E-20	3.19E-21	2.89E-19	1.57E-20	1.29E-20	1.49E-16
Isodrin	3.85E-17	1.74E-17	4.08E-20	3.41E-21	8.18E-20	4.61E-19	3.66E-21	5.65E-17
Malathion	5.88E-17	5.07E-19	5.56E-22	9.30E-23	1.25E-19	0.00E+00	5.59E-21	5.95E-17
Methanol	1.67E-12	1.38E-12	4.29E-19	7.26E-20	3.55E-15	2.15E-17	1.59E-16	3.06E-12

Table 8-12
(continued)

Methyl Chloride	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Methylene Chloride	1.44E-13	NA	NA	NA	NA	NA	NA	1.44E-13
4-Nitrophenol	6.09E-16	9.40E-18	5.87E-21	9.81E-22	1.29E-18	1.10E-19	5.78E-20	6.20E-16
PAHs								
Acenaphthalene	7.21E-13	1.14E-14	2.29E-17	3.64E-18	1.53E-15	2.14E-16	6.84E-17	7.34E-13
Acenaphthene	7.21E-13	5.66E-15	1.95E-17	3.13E-18	1.53E-15	8.31E-17	6.84E-17	7.28E-13
Benzo(a)pyrene	1.44E-13	8.91E-17	8.87E-17	4.38E-18	5.38E-18	2.85E-17	2.41E-19	1.44E-13
Chrysene	1.44E-13	9.99E-17	2.11E-17	1.08E-18	6.75E-18	7.21E-16	3.02E-19	1.45E-13
Dibenzo(a,h)anthracene	1.44E-13	9.08E-17	1.07E-16	5.30E-18	7.32E-18	1.62E-14	3.27E-19	1.60E-13
Fluoranthene	4.32E-13	3.32E-16	1.75E-17	9.47E-19	1.97E-17	NA	8.83E-19	4.33E-13
Fluorene	1.44E-13	1.39E-15	6.44E-18	9.94E-19	3.06E-16	5.95E-17	1.37E-17	1.46E-13
Phenanthrene	2.88E-13	2.05E-16	2.70E-18	1.56E-19	9.34E-18	2.00E-16	4.18E-19	2.88E-13
Pyrene	1.44E-13	1.02E-16	5.24E-18	2.76E-19	4.53E-18	1.64E-16	2.03E-19	1.44E-13
Parathion	8.12E-18	6.73E-20	1.96E-22	3.16E-23	1.72E-20	1.48E-21	7.71E-22	8.21E-18
Pentachlorobenzene	2.20E-15	3.71E-17	2.31E-19	3.17E-20	4.67E-18	NA	2.09E-19	2.24E-15
Phenol	7.80E-12	8.53E-13	1.82E-17	3.07E-18	1.66E-14	4.75E-17	7.40E-16	8.67E-12
Pyridine	6.91E-17	NA	NA	NA	NA	NA	NA	6.91E-17
Quinoline	3.44E-16	1.30E-17	1.40E-21	2.36E-22	7.31E-19	2.76E-20	3.27E-20	3.58E-16
Styrene	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Supona	2.44E-17	2.56E-19	2.87E-22	4.78E-23	5.18E-20	4.80E-21	2.32E-21	2.47E-17
Tetrachlorobenzene	9.27E-16	3.57E-17	4.10E-20	6.34E-21	1.97E-18	NA	8.80E-20	9.65E-16
Tetrachloroethene	5.74E-15	NA	NA	NA	NA	NA	NA	5.74E-15
Toluene	7.21E-13	NA	NA	NA	NA	NA	NA	7.21E-13
Trichlorobenzene	4.88E-16	2.50E-18	1.41E-20	2.25E-21	1.04E-18	2.16E-19	4.64E-20	4.92E-16
Trichloroethene	8.83E-16	NA	NA	NA	NA	NA	NA	8.83E-16
Urea	1.06E-11	1.51E-10	3.39E-19	5.74E-20	2.24E-14	1.36E-16	1.00E-15	1.62E-10
Vapona	6.50E-17	3.00E-18	1.43E-22	2.42E-23	1.38E-19	1.99E-21	6.17E-21	6.82E-17
Vinyl Chloride	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Xylene	2.88E-13	NA	NA	NA	NA	NA	NA	2.88E-13
INORGANICS								
Aluminum	1.91E-07	NA	NA	NA	NA	NE	NA	1.91E-07
Ammonia	3.44E-08	NA	NA	NA	NA	NA	NA	3.44E-08
Antimony	6.71E-09	5.89E-12	4.85E-14	2.17E-14	1.42E-11	NA	6.37E-14	6.73E-09
Arsenic	3.80E-08	2.52E-11	4.15E-11	2.34E-13	8.06E-11	3.37E-11	3.60E-13	3.81E-08
Barium	9.30E-09	7.02E-12	3.45E-13	3.78E-15	1.97E-11	NE	8.83E-14	9.32E-09
Beryllium	3.88E-10	2.43E-13	1.20E-17	2.49E-16	8.25E-13	1.73E-14	3.69E-15	3.89E-10
Boron	2.83E-07	NA	NA	NA	NA	NE	NA	2.83E-07
Cadmium	1.11E-09	NA	NA	NA	NA	8.53E-13	NA	1.11E-09
Calcium	1.63E-06	NA	NA	NA	NA	NA	NA	1.63E-06
Chromium (III)	2.52E-09	NA	NA	NA	NA	NA	NA	2.52E-09
Chromium (VI)	8.88E-11	NA	NA	NA	NA	3.23E-14	NA	8.89E-11
Cobalt	8.36E-09	NA	NA	NA	NA	3.92E-13	NA	8.36E-09
Copper	3.56E-05	9.25E-08	2.23E-08	6.57E-09	7.56E-08	1.01E-07	3.38E-10	3.59E-05
Cyanogen	6.91E-17	NA	NA	NA	NA	NA	NA	6.91E-17
Hydrogen Cyanide	6.83E-13	NA	NA	NA	NA	NA	NA	6.83E-13
Iron	5.06E-07	NA	NA	NA	NA	NE	NA	5.06E-07
Lead	1.19E-08	8.21E-12	3.02E-13	1.18E-14	2.53E-11	5.15E-12	1.13E-13	1.20E-08
Lithium	1.17E-09	NA	NA	NA	NA	NE	NA	1.17E-09
Magnesium	1.51E-06	NA	NA	NA	NA	NE	NA	1.51E-06

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Table 8-12
(continued)

Manganese	6.53E-08	NA	NA	NA	NA	NA	NA	6.53E-08
Mercury	1.05E-08	2.43E-11	1.59E-12	5.07E-11	2.23E-11	NA	9.97E-14	1.06E-08
Molybdenum	1.17E-07	NA	NA	NA	NA	NE	NA	1.17E-07
Nickel	3.03E-07	NA	NA	NA	NA	NA	NA	3.03E-07
Phosphate	3.53E-05	NA	NA	NA	NA	NA	NA	3.53E-05
Potassium	1.20E-05	NA	NA	NA	NA	NA	NA	1.20E-05
Selenium	9.74E-05	7.86E-08	7.61E-08	7.03E-09	2.07E-07	3.95E-09	9.25E-10	9.78E-05
Silicon	1.68E-06	NA	NA	NA	NA	NA	NA	1.68E-06
Silver	1.01E-06	1.47E-09	6.31E-09	3.61E-11	2.14E-09	7.80E-09	9.58E-12	1.03E-06
Sodium	1.24E-03	NA	NA	NA	NA	NA	NA	1.24E-03
Strontium	3.88E-10	NA	NA	NA	NA	NE	NA	3.88E-10
Thallium	9.80E-08	6.03E-11	5.99E-12	1.99E-12	2.08E-10	NA	9.30E-13	9.82E-08
Tin	8.56E-08	NA	NA	NA	NA	NE	NA	8.56E-08
Titanium	6.47E-10	NA	NA	NA	NA	NE	NA	6.47E-10
Vanadium	2.48E-08	NA	NA	NA	NA	5.82E-13	NA	2.48E-08
Yittrium	2.27E-10	NA	NA	NA	NA	NE	NA	2.27E-10
Zinc	1.72E-07	NA	NA	NA	NA	2.39E-10	NA	1.73E-07
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	5.00E-05	NA	NA	NA	NA	NA	NA	5.00E-05
Hydrogen Chloride	5.00E-05	NA	NA	NA	NA	NA	NA	5.00E-05
Hydrogen Fluorides	1.77E-06	NA	NA	NA	NA	NA	NA	1.77E-06
Nitric Acid	4.12E-05	NA	NA	NA	NA	NA	NA	4.12E-05
Nitrogen Dioxide	3.41E-04	NA	NA	NA	NA	NA	NA	3.41E-04
Particulate Matter	1.47E-04	NA	NA	NA	NA	NA	NA	1.47E-04
Sulfur Dioxide	2.59E-04	NA	NA	NA	NA	NA	NA	2.59E-04
Sulfuric Acid Mist	1.09E-04	NA	NA	NA	NA	NA	NA	1.09E-04

NA = Not applicable
NE = Not evaluted

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Table 8-13

Maximum Total Pollutant Daily Intake for Child, Resident-A Scenario

Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
	Daily Intake (mg/kg/day)							
ORGANICS								
Acetone	1.14E-16	NA	NA	NA	NA	NA	NA	1.14E-16
Acetonitrile	6.91E-15	5.14E-15	2.89E-21	4.86E-22	1.49E-17	1.90E-21	6.66E-19	1.21E-14
Acrylonitrile	6.91E-16	NA	NA	NA	NA	NA	NA	6.91E-16
Aldrin	7.33E-17	1.14E-17	1.50E-17	7.34E-19	1.58E-19	4.71E-22	7.06E-21	1.01E-16
Atrazine	1.63E-17	4.50E-19	1.05E-22	1.02E-23	1.18E-20	0.00E+00	5.27E-22	1.67E-17
Benzaldehyde	1.50E-12	9.50E-14	3.98E-18	6.29E-19	3.23E-15	5.21E-17	1.45E-16	1.60E-12
Benzene	1.48E-12	NA	NA	NA	NA	NA	NA	1.48E-12
Benzofuran	2.88E-12	1.16E-13	3.29E-17	4.24E-18	6.21E-15	4.50E-16	2.77E-16	3.00E-12
Benzoic Acid	7.27E-13	3.48E-14	2.99E-18	4.53E-19	1.57E-15	4.53E-17	7.00E-17	7.63E-13
Benzonitrile	6.91E-16	4.11E-17	2.00E-21	3.14E-22	1.49E-18	2.67E-20	6.66E-20	7.34E-16
Biphenyl	7.21E-13	NA	NA	NA	NA	NA	NA	7.21E-13
Bromomethane	1.44E-13	NA	NA	NA	NA	NA	NA	1.44E-13
Carbazole	1.38E-16	4.49E-18	4.11E-21	4.31E-22	2.98E-19	2.88E-20	1.33E-20	1.43E-16
Carbon Tetrachloride	4.59E-16	NA	NA	NA	NA	NA	NA	4.59E-16
Chlorobenzene	3.56E-13	NA	NA	NA	NA	NA	NA	3.56E-13
4-Chlorobiphenyl	8.36E-13	2.15E-14	5.95E-16	3.54E-17	1.80E-15	1.26E-16	8.05E-17	8.60E-13
4,4-Chlorobiphenyl	1.09E-14	2.69E-16	3.52E-17	1.87E-18	2.36E-17	5.53E-19	1.05E-18	1.13E-14
Chloroform	7.27E-17	NA	NA	NA	NA	NA	NA	7.27E-17
4-Chlorophenylmethylsulfone	2.67E-16	1.41E-17	2.99E-22	4.64E-23	3.10E-19	6.66E-21	1.39E-20	2.82E-16
4-Chlorophenylmethylsulfoxide	9.94E-16	4.90E-17	1.29E-21	1.97E-22	1.15E-18	2.45E-20	5.16E-20	1.04E-15
p,p-DDE	1.22E-13	2.64E-15	5.01E-16	2.62E-17	2.42E-16	1.44E-15	1.08E-17	1.27E-13
p,p-DDT	2.44E-17	7.12E-19	4.61E-19	2.30E-20	4.85E-20	3.00E-19	2.17E-21	2.59E-17
Dibenzofuran	1.44E-13	4.01E-15	1.99E-17	1.50E-18	3.10E-16	4.45E-17	1.39E-17	1.48E-13
Dichlorobenzenes (total)	2.59E-16	NA	NA	NA	NA	NA	NA	2.59E-16
1,4-Dichlorobenzene	1.64E-17	NA	NA	NA	NA	NA	NA	1.64E-17
1,1-Dichloroethene	4.03E-16	NA	NA	NA	NA	NA	NA	4.03E-16
1,2-Dichloroethene	2.80E-16	NA	NA	NA	NA	NA	NA	2.80E-16
1,2-Dichloropropane	3.27E-17	NA	NA	NA	NA	NA	NA	3.27E-17
Dieldrin	1.50E-17	1.39E-17	1.97E-19	9.97E-21	3.24E-20	2.01E-20	1.45E-21	2.92E-17
Diisopropyl Methylphosphonate	2.64E-15	1.16E-16	6.97E-21	1.04E-21	4.09E-18	1.27E-19	1.83E-19	2.76E-15
1,3-Dimethylbenzene	2.88E-13	9.58E-15	7.37E-18	7.99E-19	6.21E-16	5.84E-17	2.77E-17	2.98E-13
Dimethyldisulfide	7.33E-15	NA	NA	NA	NA	NA	NA	7.33E-15
Dimethyl Methylphosphonate	6.30E-14	6.46E-15	1.46E-22	2.40E-23	3.22E-18	6.94E-19	1.44E-19	6.94E-14
Dimethylphosphate	1.73E-14	3.70E-16	NE	NE	3.72E-17	NE	1.66E-18	1.77E-14
Dioxins/Furans (EPA TEFs)	4.41E-14	9.63E-16	4.11E-16	6.93E-17	8.95E-17	5.06E-17	4.00E-18	4.57E-14
Dithiane	2.64E-18	3.29E-19	3.33E-24	5.48E-25	5.69E-21	3.36E-23	2.54E-22	2.98E-18
Endrin	1.46E-17	3.21E-19	4.96E-21	3.18E-22	2.93E-20	2.84E-21	1.31E-21	1.50E-17
Ethylbenzene	4.32E-13	NA	NA	NA	NA	NA	NA	4.32E-13
Hexachlorobenzene	4.91E-15	1.43E-16	1.23E-17	6.55E-19	9.42E-18	9.95E-18	4.21E-19	5.09E-15
Hexachlorocyclopentadiene	1.36E-16	1.57E-17	3.75E-19	2.01E-20	2.93E-19	1.57E-20	1.31E-20	1.53E-16
Isodrin	3.85E-17	1.85E-17	1.03E-18	5.12E-20	8.30E-20	4.61E-19	3.71E-21	5.86E-17
Malathion	5.88E-17	1.74E-18	9.25E-22	1.12E-22	1.27E-19	0.00E+00	5.67E-21	6.07E-17
Methanol	1.67E-12	1.44E-12	4.37E-19	7.38E-20	3.60E-15	2.15E-17	1.61E-16	3.11E-12

Table 8-13
(continued)

Methyl Chloride	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Methylene Chloride	1.44E-13	NA	NA	NA	NA	NA	NA	1.44E-13
4-Nitrophenol	6.09E-16	2.22E-17	9.87E-21	1.18E-21	1.31E-18	1.10E-19	5.87E-20	6.33E-16
PAHs								
Acenaphthalene	7.21E-13	2.65E-14	9.01E-17	6.93E-18	1.55E-15	2.14E-16	6.94E-17	7.49E-13
Acenaphthene	7.21E-13	2.07E-14	6.72E-17	5.47E-18	1.55E-15	8.31E-17	6.94E-17	7.43E-13
Benzo(a)pyrene	1.44E-13	3.11E-15	3.10E-15	1.52E-16	1.52E-16	2.85E-17	6.79E-18	1.50E-13
Chrysene	1.44E-13	3.38E-15	7.34E-16	3.70E-17	1.72E-16	7.21E-16	7.70E-18	1.49E-13
Dibenzo(a,h)anthracene	1.44E-13	3.15E-15	3.73E-15	1.84E-16	1.79E-16	1.62E-14	8.03E-18	1.67E-13
Fluoranthene	4.32E-13	1.10E-14	6.05E-16	3.19E-17	5.11E-16	NA	2.28E-17	4.45E-13
Fluorene	1.44E-13	4.39E-15	3.38E-17	2.33E-18	3.10E-16	5.95E-17	1.39E-17	1.49E-13
Phenanthrene	2.88E-13	7.03E-15	9.32E-17	5.26E-18	2.78E-16	2.00E-16	1.24E-17	2.96E-13
Pyrene	1.44E-13	3.51E-15	1.83E-16	9.50E-18	1.36E-16	1.64E-16	6.08E-18	1.48E-13
Parathion	8.12E-18	2.37E-19	6.13E-22	5.22E-23	1.75E-20	1.48E-21	7.82E-22	8.38E-18
Pentachlorobenzene	2.20E-15	8.33E-17	2.32E-18	1.33E-19	4.73E-18	NA	2.12E-19	2.29E-15
Phenol	7.80E-12	1.03E-12	2.02E-17	3.21E-18	1.68E-14	4.75E-17	7.51E-16	8.84E-12
Pyridine	6.91E-17	NA	NA	NA	NA	NA	NA	6.91E-17
Quinoline	3.44E-16	2.03E-17	1.71E-21	2.53E-22	7.42E-19	2.76E-20	3.32E-20	3.65E-16
Styrene	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Supona	2.44E-17	7.66E-19	5.40E-22	6.05E-23	5.25E-20	4.80E-21	2.35E-21	2.52E-17
Tetrachlorobenzene	9.27E-16	5.55E-17	2.13E-19	1.47E-20	2.00E-18	NA	8.93E-20	9.85E-16
Tetrachloroethene	5.74E-15	NA	NA	NA	NA	NA	NA	5.74E-15
Toluene	7.21E-13	NA	NA	NA	NA	NA	NA	7.21E-13
Trichlorobenzene	4.88E-16	1.27E-17	5.11E-20	4.07E-21	1.05E-18	2.16E-19	4.70E-20	5.02E-16
Trichloroethene	8.83E-16	NA	NA	NA	NA	NA	NA	8.83E-16
Urea	1.06E-11	1.54E-10	3.44E-19	5.82E-20	2.28E-14	1.36E-16	1.02E-15	1.64E-10
Vapona	6.50E-17	4.40E-18	1.58E-22	2.52E-23	1.40E-19	1.99E-21	6.26E-21	6.96E-17
Vinyl Chloride	1.44E-12	NA	NA	NA	NA	NA	NA	1.44E-12
Xylene	2.88E-13	NA	NA	NA	NA	NA	NA	2.88E-13
INORGANICS								
Aluminum	1.91E-07	NA	NA	NA	NA	NE	NA	1.91E-07
Ammonia	3.44E-08	NA	NA	NA	NA	NA	NA	3.44E-08
Antimony	6.71E-09	1.45E-10	7.01E-13	1.24E-13	1.45E-11	NA	6.46E-14	6.87E-09
Arsenic	3.80E-08	8.14E-10	2.63E-10	1.39E-12	8.18E-11	3.37E-11	3.66E-13	3.91E-08
Barium	9.30E-09	2.00E-10	3.51E-12	2.51E-14	2.00E-11	NE	8.96E-14	9.52E-09
Beryllium	3.88E-10	8.32E-12	3.52E-16	6.16E-15	8.37E-13	1.73E-14	3.74E-15	3.98E-10
Boron	2.83E-07	NA	NA	NA	NA	NE	NA	2.83E-07
Cadmium	1.11E-09	NA	NA	NA	NA	8.53E-13	NA	1.11E-09
Calcium	1.63E-06	NA	NA	NA	NA	NA	NA	1.63E-06
Chromium (III)	2.52E-09	NA	NA	NA	NA	NA	NA	2.52E-09
Chromium (VI)	8.88E-11	NA	NA	NA	NA	3.23E-14	NA	8.89E-11
Cobalt	8.36E-09	NA	NA	NA	NA	3.92E-13	NA	8.36E-09
Copper	3.56E-05	8.33E-07	7.45E-08	1.21E-08	7.67E-08	1.01E-07	3.43E-10	3.67E-05
Cyanogen	6.91E-17	NA	NA	NA	NA	NA	NA	6.91E-17
Hydrogen Cyanide	6.83E-13	NA	NA	NA	NA	NA	NA	6.83E-13
Iron	5.06E-07	NA	NA	NA	NA	NE	NA	5.06E-07
Lead	1.19E-08	2.56E-10	3.20E-12	6.64E-14	2.57E-11	5.15E-12	1.15E-13	1.22E-08
Lithium	1.17E-09	NA	NA	NA	NA	NE	NA	1.17E-09
Magnesium	1.51E-06	NA	NA	NA	NA	NE	NA	1.51E-06

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Table 8-13
(continued)

Manganese	6.53E-08	NA	NA	NA	NA	NA	NA	6.53E-08
Mercury	1.05E-08	2.43E-10	6.20E-12	9.14E-11	2.26E-11	NA	1.01E-13	1.09E-08
Molybdenum	1.17E-07	NA	NA	NA	NA	NE	NA	1.17E-07
Nickel	3.03E-07	NA	NA	NA	NA	NA	NA	3.03E-07
Phosphate	3.53E-05	NA	NA	NA	NA	NA	NA	3.53E-05
Potassium	1.20E-05	NA	NA	NA	NA	NA	NA	1.20E-05
Selenium	9.74E-05	2.10E-06	4.56E-07	2.94E-08	2.10E-07	3.95E-09	9.38E-10	1.00E-04
Silicon	1.68E-06	NA	NA	NA	NA	NA	NA	1.68E-06
Silver	1.01E-06	2.25E-08	2.60E-08	8.27E-11	2.17E-09	7.80E-09	9.72E-12	1.07E-06
Sodium	1.24E-03	NA	NA	NA	NA	NA	NA	1.24E-03
Strontium	3.88E-10	NA	NA	NA	NA	NE	NA	3.88E-10
Thallium	9.80E-08	2.10E-09	1.97E-10	6.17E-11	2.11E-10	NA	9.44E-13	1.01E-07
Tin	8.56E-08	NA	NA	NA	NA	NE	NA	8.56E-08
Titanium	6.47E-10	NA	NA	NA	NA	NE	NA	6.47E-10
Vanadium	2.48E-08	NA	NA	NA	NA	5.82E-13	NA	2.48E-08
Yittrium	2.27E-10	NA	NA	NA	NA	NE	NA	2.27E-10
Zinc	1.72E-07	NA	NA	NA	NA	2.39E-10	NA	1.73E-07
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	5.00E-05	NA	NA	NA	NA	NA	NA	5.00E-05
Hydrogen Chloride	5.00E-05	NA	NA	NA	NA	NA	NA	5.00E-05
Hydrogen Fluorides	1.77E-06	NA	NA	NA	NA	NA	NA	1.77E-06
Nitric Acid	4.12E-05	NA	NA	NA	NA	NA	NA	4.12E-05
Nitrogen Dioxide	3.41E-04	NA	NA	NA	NA	NA	NA	3.41E-04
Particulate Matter	1.47E-04	NA	NA	NA	NA	NA	NA	1.47E-04
Sulfur Dioxide	2.59E-04	NA	NA	NA	NA	NA	NA	2.59E-04
Sulfuric Acid Mist	1.09E-04	NA	NA	NA	NA	NA	NA	1.09E-04

NA = Not applicable
NE = Not evaluted

Table 8-14

Average Total Pollutant Daily Intake for Child, Resident-B Scenario

Pollutant	Daily Intake (mg/kg/day)							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	1.78E-17	NA	NA	NA	NA	NA	NA	1.78E-17
Acetonitrile	1.08E-15	7.12E-15	2.82E-21	4.78E-22	2.12E-17	1.90E-21	9.49E-19	8.22E-15
Acrylonitrile	1.08E-16	NA	NA	NA	NA	NA	NA	1.08E-16
Aldrin	1.15E-17	1.40E-17	4.81E-19	2.97E-20	2.25E-19	4.71E-22	1.01E-20	2.62E-17
Atrazine	2.55E-18	5.87E-21	3.09E-24	3.04E-25	5.19E-22	0.00E+00	2.32E-23	2.55E-18
Benzaldehyde	2.35E-13	8.98E-14	3.57E-18	6.03E-19	4.61E-15	5.21E-17	2.06E-16	3.30E-13
Benzene	2.32E-13	NA	NA	NA	NA	NA	NA	2.32E-13
Benzofuran	4.51E-13	7.72E-14	2.19E-17	3.67E-18	8.84E-15	4.50E-16	3.95E-16	5.38E-13
Benzoic Acid	1.14E-13	2.75E-14	2.53E-18	4.26E-19	2.23E-15	4.53E-17	9.98E-17	1.44E-13
Benzonitrile	1.08E-16	3.75E-17	1.78E-21	3.00E-22	2.12E-18	2.67E-20	9.49E-20	1.48E-16
Biphenyl	1.13E-13	NA	NA	NA	NA	NA	NA	1.13E-13
Bromomethane	2.26E-14	NA	NA	NA	NA	NA	NA	2.26E-14
Carbazole	2.17E-17	2.20E-18	1.95E-21	3.23E-22	4.25E-19	2.88E-20	1.90E-20	2.43E-17
Carbon Tetrachloride	7.19E-17	NA	NA	NA	NA	NA	NA	7.19E-17
Chlorobenzene	5.57E-14	NA	NA	NA	NA	NA	NA	5.57E-14
4-Chlorobiphenyl	1.31E-13	5.25E-15	6.96E-17	9.92E-18	2.57E-15	1.26E-16	1.15E-16	1.39E-13
4,4-Chlorobiphenyl	1.71E-15	5.10E-17	2.34E-18	2.79E-19	3.36E-17	5.53E-19	1.50E-18	1.80E-15
Chloroform	1.14E-17	NA	NA	NA	NA	NA	NA	1.14E-17
4-Chlorophenylmethylsulfone	4.18E-17	4.83E-19	1.10E-23	1.75E-24	1.71E-20	6.66E-21	7.63E-22	4.23E-17
4-Chlorophenylmethylsulfoxide	1.56E-16	1.61E-18	4.74E-23	7.43E-24	6.35E-20	2.45E-20	2.84E-21	1.57E-16
p,p-DDE	1.91E-14	1.91E-17	1.70E-17	1.21E-18	6.98E-17	1.44E-15	3.12E-18	2.06E-14
p,p-DDT	3.82E-18	5.67E-20	1.42E-20	8.34E-22	1.40E-20	3.00E-19	6.25E-22	4.21E-18
Dibenzofuran	2.25E-14	1.34E-15	4.83E-18	7.64E-19	4.42E-16	4.45E-17	1.97E-17	2.44E-14
Dichlorobenzenes (total)	4.06E-17	NA	NA	NA	NA	NA	NA	4.06E-17
1,4-Dichlorobenzene	2.56E-18	NA	NA	NA	NA	NA	NA	2.56E-18
1,1-Dichloroethene	6.31E-17	NA	NA	NA	NA	NA	NA	6.31E-17
1,2-Dichloroethene	4.39E-17	NA	NA	NA	NA	NA	NA	4.39E-17
1,2-Dichloropropane	5.11E-18	NA	NA	NA	NA	NA	NA	5.11E-18
Dieldrin	2.35E-18	1.93E-17	8.96E-21	8.48E-22	4.62E-20	2.01E-20	2.06E-21	2.17E-17
Diisopropyl Methylphosphonate	4.14E-16	5.10E-18	3.65E-22	5.79E-23	3.38E-19	1.27E-19	1.51E-20	4.19E-16
1,3-Dimethylbenzene	4.51E-14	4.89E-15	3.71E-18	6.16E-19	8.84E-16	5.84E-17	3.95E-17	5.10E-14
Dimethyldisulfide	1.15E-15	NA	NA	NA	NA	NA	NA	1.15E-15
Dimethyl Methylphosphonate	9.86E-15	2.16E-16	4.18E-24	6.85E-25	1.33E-19	6.94E-19	5.95E-21	1.01E-14
Dimethylphosphate	2.70E-15	1.48E-18	NE	NE	5.30E-17	NE	2.37E-18	2.76E-15
Dioxins/Furans (EPA TEFs)	6.91E-15	1.09E-17	1.35E-17	2.98E-18	3.32E-17	5.06E-17	1.49E-18	7.02E-15
Dithiane	4.14E-19	3.89E-19	3.16E-24	5.34E-25	8.11E-21	3.36E-23	3.63E-22	8.11E-19
Endrin	2.29E-18	3.78E-21	2.64E-22	2.98E-23	9.27E-21	2.84E-21	4.15E-22	2.31E-18
Ethylbenzene	6.77E-14	NA	NA	NA	NA	NA	NA	6.77E-14
Hexachlorobenzene	7.69E-16	7.93E-18	4.06E-19	2.80E-20	1.89E-18	9.95E-18	8.43E-20	7.90E-16
Hexachlorocyclopentadiene	2.13E-17	1.83E-17	2.62E-20	3.19E-21	4.18E-19	1.57E-20	1.87E-20	4.01E-17
Isodrin	6.03E-18	2.51E-17	4.08E-20	3.41E-21	1.18E-19	4.61E-19	5.29E-21	3.18E-17
Malathion	9.21E-18	6.86E-19	5.56E-22	9.30E-23	1.81E-19	0.00E+00	8.08E-21	1.01E-17
Methanol	2.62E-13	2.00E-12	4.29E-19	7.26E-20	5.13E-15	2.15E-17	2.29E-16	2.26E-12

Table 8-14
(continued)

Methyl Chloride	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Methylene Chloride	2.26E-14	NA	NA	NA	NA	NA	NA	2.26E-14
4-Nitrophenol	9.54E-17	1.31E-17	5.87E-21	9.81E-22	1.87E-18	1.10E-19	8.36E-20	1.11E-16
PAHs								
Acenaphthalene	1.13E-13	1.59E-14	2.29E-17	3.64E-18	2.21E-15	2.14E-16	9.89E-17	1.31E-13
Acenaphthene	1.13E-13	7.60E-15	1.95E-17	3.13E-18	2.21E-15	8.31E-17	9.89E-17	1.23E-13
Benzo(a)pyrene	2.25E-14	1.40E-17	8.87E-17	4.38E-18	7.78E-18	2.85E-17	3.48E-19	2.27E-14
Chrysene	2.25E-14	2.96E-17	2.11E-17	1.08E-18	9.75E-18	7.21E-16	4.36E-19	2.33E-14
Dibenzo(a,h)anthracene	2.25E-14	1.64E-17	1.07E-16	5.30E-18	1.06E-17	1.62E-14	4.73E-19	3.88E-14
Fluoranthene	6.77E-14	1.34E-16	1.75E-17	9.47E-19	2.85E-17	NA	1.28E-18	6.79E-14
Fluorene	2.25E-14	1.89E-15	6.44E-18	9.94E-19	4.42E-16	5.95E-17	1.97E-17	2.49E-14
Phenanthrene	4.51E-14	6.67E-17	2.70E-18	1.56E-19	1.35E-17	2.00E-16	6.04E-19	4.54E-14
Pyrene	2.25E-14	3.32E-17	5.24E-18	2.76E-19	6.55E-18	1.64E-16	2.93E-19	2.27E-14
Parathion	1.27E-18	9.08E-20	1.96E-22	3.16E-23	2.49E-20	1.48E-21	1.11E-21	1.39E-18
Pentachlorobenzene	3.44E-16	5.19E-17	2.31E-19	3.17E-20	6.75E-18	NA	3.02E-19	4.03E-16
Phenol	1.22E-12	1.23E-12	1.82E-17	3.07E-18	2.39E-14	4.75E-17	1.07E-15	2.47E-12
Pyridine	1.08E-17	NA	NA	NA	NA	NA	NA	1.08E-17
Quinoline	5.39E-17	1.85E-17	1.40E-21	2.36E-22	1.06E-18	2.76E-20	4.73E-20	7.35E-17
Styrene	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Supona	3.82E-18	3.50E-19	2.87E-22	4.78E-23	7.49E-20	4.80E-21	3.35E-21	4.25E-18
Tetrachlorobenzene	1.45E-16	5.09E-17	4.10E-20	6.34E-21	2.85E-18	NA	1.27E-19	1.99E-16
Tetrachloroethene	8.98E-16	NA	NA	NA	NA	NA	NA	8.98E-16
Toluene	1.13E-13	NA	NA	NA	NA	NA	NA	1.13E-13
Trichlorobenzene	7.65E-17	3.22E-18	1.41E-20	2.25E-21	1.50E-18	2.16E-19	6.70E-20	8.15E-17
Trichloroethene	1.38E-16	NA	NA	NA	NA	NA	NA	1.38E-16
Urea	1.65E-12	2.19E-10	3.39E-19	5.74E-20	3.24E-14	1.36E-16	1.45E-15	2.21E-10
Vapona	1.02E-17	4.29E-18	1.43E-22	2.42E-23	2.00E-19	1.99E-21	8.93E-21	1.47E-17
Vinyl Chloride	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Xylene	4.51E-14	NA	NA	NA	NA	NA	NA	4.51E-14
INORGANICS								
Aluminum	2.99E-08	NA	NA	NA	NA	NE	NA	2.99E-08
Ammonia	5.39E-09	NA	NA	NA	NA	NA	NA	5.39E-09
Antimony	1.05E-09	3.17E-12	4.85E-14	2.17E-14	2.06E-11	NA	9.21E-14	1.07E-09
Arsenic	5.94E-09	6.19E-12	4.15E-11	2.34E-13	1.17E-10	3.37E-11	5.21E-13	6.14E-09
Barium	1.46E-09	2.72E-12	3.45E-13	3.78E-15	2.85E-11	NE	1.28E-13	1.49E-09
Beryllium	6.08E-11	4.08E-14	1.20E-17	2.49E-16	1.19E-12	1.73E-14	5.33E-15	6.21E-11
Boron	4.44E-08	NA	NA	NA	NA	NE	NA	4.44E-08
Cadmium	1.73E-10	NA	NA	NA	NA	8.53E-13	NA	1.74E-10
Calcium	2.55E-07	NA	NA	NA	NA	NA	NA	2.55E-07
Chromium (III)	3.95E-10	NA	NA	NA	NA	NA	NA	3.95E-10
Chromium (VI)	1.39E-11	NA	NA	NA	NA	3.23E-14	NA	1.39E-11
Cobalt	1.31E-09	NA	NA	NA	NA	3.92E-13	NA	1.31E-09
Copper	5.57E-06	1.05E-07	2.23E-08	6.57E-09	1.09E-07	1.01E-07	4.89E-10	5.92E-06
Cyanogen	1.08E-17	NA	NA	NA	NA	NA	NA	1.08E-17
Hydrogen Cyanide	1.07E-13	NA	NA	NA	NA	NA	NA	1.07E-13
Iron	7.92E-08	NA	NA	NA	NA	NE	NA	7.92E-08
Lead	1.87E-09	2.35E-12	3.02E-13	1.18E-14	3.66E-11	5.15E-12	1.64E-13	1.91E-09
Lithium	1.82E-10	NA	NA	NA	NA	NE	NA	1.82E-10
Magnesium	2.37E-07	NA	NA	NA	NA	NE	NA	2.37E-07

Table 8-14
(continued)

Manganese	1.02E-08	NA	NA	NA	NA	NA	NA	1.02E-08
Mercury	1.64E-09	2.67E-11	1.59E-12	5.07E-11	3.22E-11	NA	1.44E-13	1.76E-09
Molybdenum	1.83E-08	NA	NA	NA	NA	NE	NA	1.83E-08
Nickel	4.74E-08	NA	NA	NA	NA	NA	NA	4.74E-08
Phosphate	5.53E-06	NA	NA	NA	NA	NA	NA	5.53E-06
Potassium	1.88E-06	NA	NA	NA	NA	NA	NA	1.88E-06
Selenium	1.52E-05	3.59E-08	7.61E-08	7.03E-09	2.99E-07	3.95E-09	1.34E-09	1.57E-05
Silicon	2.63E-07	NA	NA	NA	NA	NA	NA	2.63E-07
Silver	1.58E-07	1.31E-09	6.31E-09	3.61E-11	3.10E-09	7.80E-09	1.39E-11	1.77E-07
Sodium	1.94E-04	NA	NA	NA	NA	NA	NA	1.94E-04
Strontium	6.08E-11	NA	NA	NA	NA	NE	NA	6.08E-11
Thallium	1.53E-08	8.93E-12	5.99E-12	1.99E-12	3.01E-10	NA	1.34E-12	1.57E-08
Tin	1.34E-08	NA	NA	NA	NA	NE	NA	1.34E-08
Titanium	1.01E-10	NA	NA	NA	NA	NE	NA	1.01E-10
Vanadium	3.88E-09	NA	NA	NA	NA	5.82E-13	NA	3.88E-09
Yittrium	3.55E-11	NA	NA	NA	NA	NE	NA	3.55E-11
Zinc	2.70E-08	NA	NA	NA	NA	2.39E-10	NA	2.72E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	7.83E-06	NA	NA	NA	NA	NA	NA	7.83E-06
Hydrogen Chloride	7.83E-06	NA	NA	NA	NA	NA	NA	7.83E-06
Hydrogen Fluorides	2.76E-07	NA	NA	NA	NA	NA	NA	2.76E-07
Nitric Acid	6.45E-06	NA	NA	NA	NA	NA	NA	6.45E-06
Nitrogen Dioxide	5.34E-05	NA	NA	NA	NA	NA	NA	5.34E-05
Particulate Matter	2.30E-05	NA	NA	NA	NA	NA	NA	2.30E-05
Sulfur Dioxide	4.05E-05	NA	NA	NA	NA	NA	NA	4.05E-05
Sulfuric Acid Mist	1.70E-05	NA	NA	NA	NA	NA	NA	1.70E-05

NA = Not applicable
NE = Not evaluted

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Table 8-15

Maximum Total Pollutant Daily Intake for Child, Resident-B Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	1.78E-17	NA	NA	NA	NA	NA	NA	1.78E-17
Acetonitrile	1.08E-15	7.24E-15	2.89E-21	4.86E-22	2.15E-17	1.90E-21	9.63E-19	8.34E-15
Acrylonitrile	1.08E-16	NA	NA	NA	NA	NA	NA	1.08E-16
Aldrin	1.15E-17	1.44E-17	1.50E-17	7.34E-19	2.28E-19	4.71E-22	1.02E-20	4.19E-17
Atrazine	2.55E-18	1.96E-19	1.05E-22	1.02E-23	1.70E-20	0.00E+00	7.62E-22	2.76E-18
Benzaldehyde	2.35E-13	9.55E-14	3.98E-18	6.29E-19	4.67E-15	5.21E-17	2.09E-16	3.35E-13
Benzene	2.32E-13	NA	NA	NA	NA	NA	NA	2.32E-13
Benzofuran	4.51E-13	8.67E-14	3.29E-17	4.24E-18	8.97E-15	4.50E-16	4.01E-16	5.48E-13
Benzoic Acid	1.14E-13	3.00E-14	2.99E-18	4.53E-19	2.26E-15	4.53E-17	1.01E-16	1.46E-13
Benzonitrile	1.08E-16	4.01E-17	2.00E-21	3.14E-22	2.15E-18	2.67E-20	9.63E-20	1.51E-16
Biphenyl	1.13E-13	NA	NA	NA	NA	NA	NA	1.13E-13
Bromomethane	2.26E-14	NA	NA	NA	NA	NA	NA	2.26E-14
Carbazole	2.17E-17	2.63E-18	4.11E-21	4.31E-22	4.31E-19	2.88E-20	1.93E-20	2.48E-17
Carbon Tetrachloride	7.19E-17	NA	NA	NA	NA	NA	NA	7.19E-17
Chlorobenzene	5.57E-14	NA	NA	NA	NA	NA	NA	5.57E-14
4-Chlorobiphenyl	1.31E-13	7.76E-15	5.95E-16	3.54E-17	2.60E-15	1.26E-16	1.16E-16	1.42E-13
4,4-Chlorobiphenyl	1.71E-15	8.36E-17	3.52E-17	1.87E-18	3.41E-17	5.53E-19	1.52E-18	1.87E-15
Chloroform	1.14E-17	NA	NA	NA	NA	NA	NA	1.14E-17
4-Chlorophenylmethylsulfone	4.18E-17	1.29E-17	2.99E-22	4.64E-23	4.48E-19	6.66E-21	2.00E-20	5.52E-17
4-Chlorophenylmethylsulfoxide	1.56E-16	4.31E-17	1.29E-21	1.97E-22	1.67E-18	2.45E-20	7.46E-20	2.01E-16
p,p-DDE	1.91E-14	4.09E-16	5.01E-16	2.62E-17	3.50E-16	1.44E-15	1.57E-17	2.18E-14
p,p-DDT	3.82E-18	3.47E-19	4.61E-19	2.30E-20	7.02E-20	3.00E-19	3.14E-21	5.02E-18
Dibenzofuran	2.25E-14	1.78E-15	1.99E-17	1.50E-18	4.48E-16	4.45E-17	2.00E-17	2.48E-14
Dichlorobenzenes (total)	4.06E-17	NA	NA	NA	NA	NA	NA	4.06E-17
1,4-Dichlorobenzene	2.56E-18	NA	NA	NA	NA	NA	NA	2.56E-18
1,1-Dichloroethene	6.31E-17	NA	NA	NA	NA	NA	NA	6.31E-17
1,2-Dichloroethene	4.39E-17	NA	NA	NA	NA	NA	NA	4.39E-17
1,2-Dichloropropane	5.11E-18	NA	NA	NA	NA	NA	NA	5.11E-18
Dieldrin	2.35E-18	1.96E-17	1.97E-19	9.97E-21	4.68E-20	2.01E-20	2.09E-21	2.23E-17
Diisopropyl Methylphosphonate	4.14E-16	9.32E-17	6.97E-21	1.04E-21	5.91E-18	1.27E-19	2.64E-19	5.13E-16
1,3-Dimethylbenzene	4.51E-14	5.80E-15	7.37E-18	7.99E-19	8.97E-16	5.84E-17	4.01E-17	5.19E-14
Dimethyldisulfide	1.15E-15	NA	NA	NA	NA	NA	NA	1.15E-15
Dimethyl Methylphosphonate	9.86E-15	7.57E-15	1.46E-22	2.40E-23	4.66E-18	6.94E-19	2.08E-19	1.74E-14
Dimethylphosphate	2.70E-15	5.18E-17	NE	NE	5.38E-17	NE	2.41E-18	2.81E-15
Dioxins/Furans (EPA TEFs)	6.91E-15	1.60E-16	4.11E-16	6.93E-17	1.29E-16	5.06E-17	5.78E-18	7.74E-15
Dithiane	4.14E-19	4.02E-19	3.33E-24	5.48E-25	8.23E-21	3.36E-23	3.68E-22	8.24E-19
Endrin	2.29E-18	5.54E-20	4.96E-21	3.18E-22	4.24E-20	2.84E-21	1.89E-21	2.40E-18
Ethylbenzene	6.77E-14	NA	NA	NA	NA	NA	NA	6.77E-14
Hexachlorobenzene	7.69E-16	6.90E-17	1.23E-17	6.55E-19	1.36E-17	9.95E-18	6.09E-19	8.75E-16
Hexachlorocyclopentadiene	2.13E-17	1.90E-17	3.75E-19	2.01E-20	4.24E-19	1.57E-20	1.90E-20	4.11E-17
Isodrin	6.03E-18	2.56E-17	1.03E-18	5.12E-20	1.20E-19	4.61E-19	5.37E-21	3.33E-17
Malathion	9.21E-18	8.67E-19	9.25E-22	1.12E-22	1.83E-19	0.00E+00	8.19E-21	1.03E-17
Methanol	2.62E-13	2.03E-12	4.37E-19	7.38E-20	5.20E-15	2.15E-17	2.33E-16	2.30E-12

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Table 8-15
(continued)

Methyl Chloride	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Methylene Chloride	2.26E-14	NA	NA	NA	NA	NA	NA	2.26E-14
4-Nitrophenol	9.54E-17	1.51E-17	9.87E-21	1.18E-21	1.90E-18	1.10E-19	8.48E-20	1.13E-16
PAHs								
Acenaphthalene	1.13E-13	1.82E-14	9.01E-17	6.93E-18	2.25E-15	2.14E-16	1.00E-16	1.34E-13
Acenaphthene	1.13E-13	9.81E-15	6.72E-17	5.47E-18	2.25E-15	8.31E-17	1.00E-16	1.25E-13
Benzo(a)pyrene	2.25E-14	4.78E-16	3.10E-15	1.52E-16	2.19E-16	2.85E-17	9.81E-18	2.65E-14
Chrysene	2.25E-14	8.72E-16	7.34E-16	3.70E-17	2.49E-16	7.21E-16	1.11E-17	2.52E-14
Dibenzo(a,h)anthracene	2.25E-14	5.32E-16	3.73E-15	1.84E-16	2.59E-16	1.62E-14	1.16E-17	4.34E-14
Fluoranthene	6.77E-14	3.81E-15	6.05E-16	3.19E-17	7.38E-16	NA	3.30E-17	7.29E-14
Fluorene	2.25E-14	2.33E-15	3.38E-17	2.33E-18	4.48E-16	5.95E-17	2.00E-17	2.54E-14
Phenanthrene	4.51E-14	2.11E-15	9.32E-17	5.26E-18	4.01E-16	2.00E-16	1.79E-17	4.79E-14
Pyrene	2.25E-14	1.06E-15	1.83E-16	9.50E-18	1.96E-16	1.64E-16	8.78E-18	2.41E-14
Parathion	1.27E-18	1.16E-19	6.13E-22	5.22E-23	2.53E-20	1.48E-21	1.13E-21	1.42E-18
Pentachlorobenzene	3.44E-16	5.91E-17	2.32E-18	1.33E-19	6.85E-18	NA	3.06E-19	4.13E-16
Phenol	1.22E-12	1.27E-12	2.02E-17	3.21E-18	2.43E-14	4.75E-17	1.09E-15	2.51E-12
Pyridine	1.08E-17	NA	NA	NA	NA	NA	NA	1.08E-17
Quinoline	5.39E-17	1.97E-17	1.71E-21	2.53E-22	1.07E-18	2.76E-20	4.79E-20	7.48E-17
Styrene	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Supona	3.82E-18	4.27E-19	5.40E-22	6.05E-23	7.60E-20	4.80E-21	3.40E-21	4.33E-18
Tetrachlorobenzene	1.45E-16	5.44E-17	2.13E-19	1.47E-20	2.89E-18	NA	1.29E-19	2.03E-16
Tetrachloroethene	8.98E-16	NA	NA	NA	NA	NA	NA	8.98E-16
Toluene	1.13E-13	NA	NA	NA	NA	NA	NA	1.13E-13
Trichlorobenzene	7.65E-17	4.69E-18	5.11E-20	4.07E-21	1.52E-18	2.16E-19	6.80E-20	8.30E-17
Trichloroethene	1.38E-16	NA	NA	NA	NA	NA	NA	1.38E-16
Urea	1.65E-12	2.22E-10	3.44E-19	5.82E-20	3.29E-14	1.36E-16	1.47E-15	2.24E-10
Vapona	1.02E-17	4.54E-18	1.58E-22	2.52E-23	2.03E-19	1.99E-21	9.05E-21	1.49E-17
Vinyl Chloride	2.26E-13	NA	NA	NA	NA	NA	NA	2.26E-13
Xylene	4.51E-14	NA	NA	NA	NA	NA	NA	4.51E-14
INORGANICS								
Aluminum	2.99E-08	NA	NA	NA	NA	NE	NA	2.99E-08
Ammonia	5.39E-09	NA	NA	NA	NA	NA	NA	5.39E-09
Antimony	1.05E-09	2.27E-11	7.01E-13	1.24E-13	2.09E-11	NA	9.34E-14	1.09E-09
Arsenic	5.94E-09	1.17E-10	2.63E-10	1.39E-12	1.18E-10	3.37E-11	5.29E-13	6.48E-09
Barium	1.46E-09	2.98E-11	3.51E-12	2.51E-14	2.90E-11	NE	1.29E-13	1.52E-09
Beryllium	6.08E-11	1.17E-12	3.52E-16	6.16E-15	1.21E-12	1.73E-14	5.41E-15	6.32E-11
Boron	4.44E-08	NA	NA	NA	NA	NE	NA	4.44E-08
Cadmium	1.73E-10	NA	NA	NA	NA	8.53E-13	NA	1.74E-10
Calcium	2.55E-07	NA	NA	NA	NA	NA	NA	2.55E-07
Chromium (III)	3.95E-10	NA	NA	NA	NA	NA	NA	3.95E-10
Chromium (VI)	1.39E-11	NA	NA	NA	NA	3.23E-14	NA	1.39E-11
Cobalt	1.31E-09	NA	NA	NA	NA	3.92E-13	NA	1.31E-09
Copper	5.57E-06	2.10E-07	7.45E-08	1.21E-08	1.11E-07	1.01E-07	4.96E-10	6.08E-06
Cyanogen	1.08E-17	NA	NA	NA	NA	NA	NA	1.08E-17
Hydrogen Cyanide	1.07E-13	NA	NA	NA	NA	NA	NA	1.07E-13
Iron	7.92E-08	NA	NA	NA	NA	NE	NA	7.92E-08
Lead	1.87E-09	3.71E-11	3.20E-12	6.64E-14	3.71E-11	5.15E-12	1.66E-13	1.95E-09
Lithium	1.82E-10	NA	NA	NA	NA	NE	NA	1.82E-10
Magnesium	2.37E-07	NA	NA	NA	NA	NE	NA	2.37E-07

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Table 8-15
(continued)

Manganese	1.02E-08	NA	NA	NA	NA	NA	NA	1.02E-08
Mercury	1.64E-09	5.77E-11	6.20E-12	9.14E-11	3.27E-11	NA	1.46E-13	1.83E-09
Molybdenum	1.83E-08	NA	NA	NA	NA	NE	NA	1.83E-08
Nickel	4.74E-08	NA	NA	NA	NA	NA	NA	4.74E-08
Phosphate	5.53E-06	NA	NA	NA	NA	NA	NA	5.53E-06
Potassium	1.88E-06	NA	NA	NA	NA	NA	NA	1.88E-06
Selenium	1.52E-05	3.20E-07	4.56E-07	2.94E-08	3.03E-07	3.95E-09	1.36E-09	1.64E-05
Silicon	2.63E-07	NA	NA	NA	NA	NA	NA	2.63E-07
Silver	1.58E-07	4.27E-09	2.60E-08	8.27E-11	3.14E-09	7.80E-09	1.41E-11	1.99E-07
Sodium	1.94E-04	NA	NA	NA	NA	NA	NA	1.94E-04
Strontium	6.08E-11	NA	NA	NA	NA	NE	NA	6.08E-11
Thallium	1.53E-08	2.94E-10	1.97E-10	6.17E-11	3.05E-10	NA	1.36E-12	1.62E-08
Tin	1.34E-08	NA	NA	NA	NA	NE	NA	1.34E-08
Titanium	1.01E-10	NA	NA	NA	NA	NE	NA	1.01E-10
Vanadium	3.88E-09	NA	NA	NA	NA	5.82E-13	NA	3.88E-09
Yittrium	3.55E-11	NA	NA	NA	NA	NE	NA	3.55E-11
Zinc	2.70E-08	NA	NA	NA	NA	2.39E-10	NA	2.72E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	7.83E-06	NA	NA	NA	NA	NA	NA	7.83E-06
Hydrogen Chloride	7.83E-06	NA	NA	NA	NA	NA	NA	7.83E-06
Hydrogen Fluorides	2.76E-07	NA	NA	NA	NA	NA	NA	2.76E-07
Nitric Acid	6.45E-06	NA	NA	NA	NA	NA	NA	6.45E-06
Nitrogen Dioxide	5.34E-05	NA	NA	NA	NA	NA	NA	5.34E-05
Particulate Matter	2.30E-05	NA	NA	NA	NA	NA	NA	2.30E-05
Sulfur Dioxide	4.05E-05	NA	NA	NA	NA	NA	NA	4.05E-05
Sulfuric Acid Mist	1.70E-05	NA	NA	NA	NA	NA	NA	1.70E-05

NA = Not applicable
NE = Not evaluted

Table 8-16

Average Total Pollutant Daily Intake for Child, Farmer Scenario

	Daily Intake (mg/kg/day)							
Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS								
Acetone	3.99E-17	NA	NA	NA	NA	NA	NA	3.99E-17
Acetonitrile	2.43E-15	2.72E-14	5.64E-20	9.56E-21	1.26E-17	1.90E-21	5.63E-19	2.96E-14
Acrylonitrile	2.43E-16	NA	NA	NA	NA	NA	NA	2.43E-16
Aldrin	2.57E-17	1.03E-16	9.62E-18	5.95E-19	1.33E-19	4.71E-22	5.96E-21	1.39E-16
Atrazine	5.71E-18	2.73E-20	6.18E-23	6.09E-24	3.08E-22	0.00E+00	1.38E-23	5.74E-18
Benzaldehyde	5.26E-13	1.79E-13	7.14E-17	1.21E-17	2.73E-15	5.21E-17	1.22E-16	7.08E-13
Benzene	5.19E-13	NA	NA	NA	NA	NA	NA	5.19E-13
Benzofuran	1.01E-12	3.79E-13	4.38E-16	7.35E-17	5.24E-15	4.50E-16	2.34E-16	1.40E-12
Benzoic Acid	2.55E-13	6.34E-14	5.05E-17	8.53E-18	1.32E-15	4.53E-17	5.91E-17	3.20E-13
Benzonitrile	2.43E-16	7.67E-17	3.56E-20	6.01E-21	1.26E-18	2.67E-20	5.63E-20	3.21E-16
Biphenyl	2.53E-13	NA	NA	NA	NA	NA	NA	2.53E-13
Bromomethane	5.06E-14	NA	NA	NA	NA	NA	NA	5.06E-14
Carbazole	4.85E-17	1.22E-17	3.90E-20	6.46E-21	2.52E-19	2.88E-20	1.13E-20	6.10E-17
Carbon Tetrachloride	1.61E-16	NA	NA	NA	NA	NA	NA	1.61E-16
Chlorobenzene	1.25E-13	NA	NA	NA	NA	NA	NA	1.25E-13
4-Chlorobiphenyl	2.93E-13	3.57E-14	1.39E-15	1.98E-16	1.52E-15	1.26E-16	6.80E-17	3.32E-13
4,4-Chlorobiphenyl	3.84E-15	3.58E-16	4.67E-17	5.57E-18	1.99E-17	5.53E-19	8.91E-19	4.27E-15
Chloroform	2.55E-17	NA	NA	NA	NA	NA	NA	2.55E-17
4-Chlorophenylmethylsulfone	9.37E-17	8.83E-19	2.21E-22	3.50E-23	1.01E-20	6.66E-21	4.53E-22	9.46E-17
4-Chlorophenylmethylsulfoxide	3.49E-16	3.46E-18	9.48E-22	1.49E-22	3.77E-20	2.45E-20	1.68E-21	3.52E-16
p,p-DDE	4.27E-14	7.73E-17	3.41E-16	2.41E-17	4.14E-17	1.44E-15	1.85E-18	4.47E-14
p,p-DDT	8.56E-18	4.09E-19	2.84E-19	1.67E-20	8.28E-21	3.00E-19	3.70E-22	9.58E-18
Dibenzofuran	5.05E-14	8.49E-15	9.65E-17	1.53E-17	2.62E-16	4.45E-17	1.17E-17	5.94E-14
Dichlorobenzenes (total)	9.09E-17	NA	NA	NA	NA	NA	NA	9.09E-17
1,4-Dichlorobenzene	5.75E-18	NA	NA	NA	NA	NA	NA	5.75E-18
1,1-Dichloroethene	1.41E-16	NA	NA	NA	NA	NA	NA	1.41E-16
1,2-Dichloroethene	9.84E-17	NA	NA	NA	NA	NA	NA	9.84E-17
1,2-Dichloropropane	1.15E-17	NA	NA	NA	NA	NA	NA	1.15E-17
Dieldrin	5.27E-18	1.42E-16	1.79E-19	1.70E-20	2.74E-20	2.01E-20	1.22E-21	1.48E-16
Diisopropyl Methylphosphonate	9.27E-16	1.14E-17	7.31E-21	1.16E-21	2.00E-19	1.27E-19	8.95E-21	9.39E-16
1,3-Dimethylbenzene	1.01E-13	2.67E-14	7.42E-17	1.23E-17	5.24E-16	5.84E-17	2.34E-17	1.28E-13
Dimethyldisulfide	2.57E-15	NA	NA	NA	NA	NA	NA	2.57E-15
Dimethyl Methylphosphonate	2.21E-14	3.36E-16	8.37E-23	1.37E-23	7.89E-20	6.94E-19	3.53E-21	2.24E-14
Dimethylphosphate	6.06E-15	5.65E-18	NE	NE	3.14E-17	NE	1.41E-18	6.10E-15
Dioxins/Furans (EPA TEFs)	1.55E-14	5.97E-17	2.71E-16	5.96E-17	1.97E-17	5.06E-17	8.81E-19	1.59E-14
Dithiane	9.27E-19	6.72E-19	6.31E-23	1.07E-23	4.81E-21	3.36E-23	2.15E-22	1.60E-18
Endrin	5.13E-18	7.53E-21	5.29E-21	5.97E-22	5.50E-21	2.84E-21	2.46E-22	5.15E-18
Ethylbenzene	1.52E-13	NA	NA	NA	NA	NA	NA	1.52E-13
Hexachlorobenzene	1.72E-15	5.60E-17	8.12E-18	5.60E-19	1.12E-18	9.95E-18	5.00E-20	1.80E-15
Hexachlorocyclopentadiene	4.78E-17	1.35E-16	5.23E-19	6.39E-20	2.48E-19	1.57E-20	1.11E-20	1.83E-16
Isodrin	1.35E-17	1.85E-16	8.17E-19	6.82E-20	7.02E-20	4.61E-19	3.14E-21	2.00E-16
Malathion	2.06E-17	2.16E-18	1.11E-20	1.86E-21	1.07E-19	0.00E+00	4.79E-21	2.29E-17
Methanol	5.86E-13	3.11E-12	8.57E-18	1.45E-18	3.04E-15	2.15E-17	1.36E-16	3.70E-12

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Table 8-16
(continued)

Methyl Chloride	5.06E-13	NA	NA	NA	NA	NA	NA	5.06E-13
Methylene Chloride	5.06E-14	NA	NA	NA	NA	NA	NA	5.06E-14
4-Nitrophenol	2.14E-16	6.74E-17	1.17E-19	1.96E-20	1.11E-18	1.10E-19	4.96E-20	2.83E-16
PAHs								
Acenaphthalene	2.53E-13	1.10E-13	4.58E-16	7.28E-17	1.31E-15	2.14E-16	5.87E-17	3.65E-13
Acenaphthene	2.53E-13	4.69E-14	3.90E-16	6.27E-17	1.31E-15	8.31E-17	5.87E-17	3.02E-13
Benzo(a)pyrene	5.05E-14	5.82E-17	1.77E-15	8.76E-17	4.61E-18	2.85E-17	2.06E-19	5.24E-14
Chrysene	5.05E-14	1.71E-16	4.22E-16	2.16E-17	5.78E-18	7.21E-16	2.58E-19	5.18E-14
Dibenzo(a,h)anthracene	5.05E-14	7.59E-17	2.14E-15	1.06E-16	6.27E-18	1.62E-14	2.81E-19	6.90E-14
Fluoranthene	1.52E-13	8.39E-16	3.50E-16	1.89E-17	1.69E-17	NA	7.57E-19	1.53E-13
Fluorene	5.05E-14	1.29E-14	1.29E-16	1.99E-17	2.62E-16	5.95E-17	1.17E-17	6.39E-14
Phenanthrene	1.01E-13	3.81E-16	5.39E-17	3.11E-18	8.01E-18	2.00E-16	3.58E-19	1.02E-13
Pyrene	5.05E-14	1.96E-16	1.05E-16	5.51E-18	3.88E-18	1.64E-16	1.74E-19	5.10E-14
Parathion	2.85E-18	5.51E-19	3.91E-21	6.33E-22	1.48E-20	1.48E-21	6.61E-22	3.42E-18
Pentachlorobenzene	7.71E-16	3.76E-16	4.62E-18	6.34E-19	4.00E-18	NA	1.79E-19	1.16E-15
Phenol	2.74E-12	6.47E-12	3.64E-16	6.15E-17	1.42E-14	4.75E-17	6.35E-16	9.22E-12
Pyridine	2.43E-17	NA	NA	NA	NA	NA	NA	2.43E-17
Quinoline	1.21E-16	8.29E-17	2.80E-20	4.72E-21	6.27E-19	2.76E-20	2.80E-20	2.04E-16
Styrene	5.07E-13	NA	NA	NA	NA	NA	NA	5.07E-13
Supona	8.56E-18	1.69E-18	5.74E-21	9.55E-22	4.44E-20	4.80E-21	1.99E-21	1.03E-17
Tetrachlorobenzene	3.25E-16	3.69E-16	8.20E-19	1.27E-19	1.69E-18	NA	7.54E-20	6.97E-16
Tetrachloroethene	2.01E-15	NA	NA	NA	NA	NA	NA	2.01E-15
Toluene	2.53E-13	NA	NA	NA	NA	NA	NA	2.53E-13
Trichlorobenzene	1.71E-16	1.80E-17	2.82E-19	4.51E-20	8.89E-19	2.16E-19	3.97E-20	1.91E-16
Trichloroethene	3.10E-16	NA	NA	NA	NA	NA	NA	3.10E-16
Urea	3.71E-12	3.19E-10	6.77E-18	1.15E-18	1.92E-14	1.36E-16	8.60E-16	3.22E-10
Vapona	2.28E-17	8.33E-18	2.86E-21	4.84E-22	1.18E-19	1.99E-21	5.29E-21	3.13E-17
Vinyl Chloride	5.06E-13	NA	NA	NA	NA	NA	NA	5.06E-13
Xylene	1.01E-13	NA	NA	NA	NA	NA	NA	1.01E-13
INORGANICS								
Aluminum	6.70E-08	NA	NA	NA	NA	NE	NA	6.70E-08
Ammonia	1.21E-08	NA	NA	NA	NA	NA	NA	1.21E-08
Antimony	2.35E-09	7.27E-12	9.70E-13	4.34E-13	1.22E-11	NA	5.46E-14	2.37E-09
Arsenic	1.33E-08	1.82E-11	8.29E-10	4.68E-12	6.91E-11	3.37E-11	3.09E-13	1.43E-08
Barium	3.26E-09	6.68E-12	6.90E-12	7.57E-14	1.69E-11	NE	7.57E-14	3.29E-09
Beryllium	1.36E-10	1.42E-13	2.39E-16	4.98E-15	7.07E-13	1.73E-14	3.16E-15	1.37E-10
Boron	9.94E-08	NA	NA	NA	NA	NE	NA	9.94E-08
Cadmium	3.88E-10	NA	NA	NA	NA	8.53E-13	NA	3.89E-10
Calcium	5.71E-07	NA	NA	NA	NA	NA	NA	5.71E-07
Chromium (III)	8.85E-10	NA	NA	NA	NA	NA	NA	8.85E-10
Chromium (VI)	3.12E-11	NA	NA	NA	NA	3.23E-14	NA	3.12E-11
Cobalt	2.93E-09	NA	NA	NA	NA	3.92E-13	NA	2.93E-09
Copper	1.25E-05	2.25E-07	4.45E-07	1.31E-07	6.48E-08	1.01E-07	2.90E-10	1.35E-05
Cyanogen	2.43E-17	NA	NA	NA	NA	NA	NA	2.43E-17
Hydrogen Cyanide	2.39E-13	NA	NA	NA	NA	NA	NA	2.39E-13
Iron	1.78E-07	NA	NA	NA	NA	NE	NA	1.78E-07
Lead	4.18E-09	6.56E-12	6.03E-12	2.37E-13	2.17E-11	5.15E-12	9.70E-14	4.22E-09
Lithium	4.09E-10	NA	NA	NA	NA	NE	NA	4.09E-10
Magnesium	5.31E-07	NA	NA	NA	NA	NE	NA	5.31E-07

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Table 8-16
(continued)

Manganese	2.29E-08	NA	NA	NA	NA	NA	NA	2.29E-08
Mercury	3.69E-09	5.53E-11	3.17E-11	1.01E-09	1.91E-11	NA	8.55E-14	4.80E-09
Molybdenum	4.10E-08	NA	NA	NA	NA	NE	NA	4.10E-08
Nickel	1.06E-07	NA	NA	NA	NA	NA	NA	1.06E-07
Phosphate	1.24E-05	NA	NA	NA	NA	NA	NA	1.24E-05
Potassium	4.22E-06	NA	NA	NA	NA	NA	NA	4.22E-06
Selenium	3.42E-05	8.98E-08	1.52E-06	1.41E-07	1.77E-07	3.95E-09	7.93E-10	3.61E-05
Silicon	5.88E-07	NA	NA	NA	NA	NA	NA	5.88E-07
Silver	3.54E-07	2.81E-09	1.26E-07	7.21E-10	1.84E-09	7.80E-09	8.21E-12	4.93E-07
Sodium	4.35E-04	NA	NA	NA	NA	NA	NA	4.35E-04
Strontium	1.36E-10	NA	NA	NA	NA	NE	NA	1.36E-10
Thallium	3.44E-08	3.31E-11	1.20E-10	3.97E-11	1.78E-10	NA	7.97E-13	3.47E-08
Tin	3.00E-08	NA	NA	NA	NA	NE	NA	3.00E-08
Titanium	2.27E-10	NA	NA	NA	NA	NE	NA	2.27E-10
Vanadium	8.69E-09	NA	NA	NA	NA	5.82E-13	NA	8.69E-09
Yittrium	7.95E-11	NA	NA	NA	NA	NE	NA	7.95E-11
Zinc	6.05E-08	NA	NA	NA	NA	2.39E-10	NA	6.07E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	1.75E-05	NA	NA	NA	NA	NA	NA	1.75E-05
Hydrogen Chloride	1.75E-05	NA	NA	NA	NA	NA	NA	1.75E-05
Hydrogen Fluorides	6.19E-07	NA	NA	NA	NA	NA	NA	6.19E-07
Nitric Acid	1.45E-05	NA	NA	NA	NA	NA	NA	1.45E-05
Nitrogen Dioxide	1.20E-04	NA	NA	NA	NA	NA	NA	1.20E-04
Particulate Matter	5.16E-05	NA	NA	NA	NA	NA	NA	5.16E-05
Sulfur Dioxide	9.08E-05	NA	NA	NA	NA	NA	NA	9.08E-05
Sulfuric Acid Mist	3.82E-05	NA	NA	NA	NA	NA	NA	3.82E-05

NA = Not applicable
NE = Not evaluted

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Table 8-17

Maximum Total Pollutant Daily Intake for Child, Farmer Scenario

Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
	Daily Intake (mg/kg/day)							
ORGANICS								
Acetone	3.99E-17	NA	NA	NA	NA	NA	NA	3.99E-17
Acetonitrile	2.43E-15	2.77E-14	5.78E-20	9.72E-21	1.28E-17	1.90E-21	5.71E-19	3.01E-14
Acrylonitrile	2.43E-16	NA	NA	NA	NA	NA	NA	2.43E-16
Aldrin	2.57E-17	1.05E-16	3.01E-16	1.47E-17	1.35E-19	4.71E-22	6.05E-21	4.47E-16
Atrazine	5.71E-18	9.09E-19	2.11E-21	2.04E-22	1.01E-20	0.00E+00	4.52E-22	6.63E-18
Benzaldehyde	5.26E-13	1.98E-13	7.96E-17	1.26E-17	2.77E-15	5.21E-17	1.24E-16	7.28E-13
Benzene	5.19E-13	NA	NA	NA	NA	NA	NA	5.19E-13
Benzofuran	1.01E-12	4.17E-13	6.57E-16	8.48E-17	5.32E-15	4.50E-16	2.38E-16	1.43E-12
Benzoic Acid	2.55E-13	7.24E-14	5.98E-17	9.06E-18	1.34E-15	4.53E-17	6.00E-17	3.29E-13
Benzonitrile	2.43E-16	8.55E-17	4.00E-20	6.29E-21	1.28E-18	2.67E-20	5.71E-20	3.30E-16
Biphenyl	2.53E-13	NA	NA	NA	NA	NA	NA	2.53E-13
Bromomethane	5.06E-14	NA	NA	NA	NA	NA	NA	5.06E-14
Carbazole	4.85E-17	1.39E-17	8.22E-20	8.61E-21	2.55E-19	2.88E-20	1.14E-20	6.28E-17
Carbon Tetrachloride	1.61E-16	NA	NA	NA	NA	NA	NA	1.61E-16
Chlorobenzene	1.25E-13	NA	NA	NA	NA	NA	NA	1.25E-13
4-Chlorobiphenyl	2.93E-13	4.55E-14	1.19E-14	7.09E-16	1.54E-15	1.26E-16	6.90E-17	3.53E-13
4,4-Chlorobiphenyl	3.84E-15	4.85E-16	7.05E-16	3.75E-17	2.02E-17	5.53E-19	9.04E-19	5.09E-15
Chloroform	2.55E-17	NA	NA	NA	NA	NA	NA	2.55E-17
4-Chlorophenylmethylsulfone	9.37E-17	2.40E-17	5.97E-21	9.28E-22	2.66E-19	6.66E-21	1.19E-20	1.18E-16
4-Chlorophenylmethylsulfoxide	3.49E-16	9.37E-17	2.58E-20	3.94E-21	9.89E-19	2.45E-20	4.42E-20	4.44E-16
p,p-DDE	4.27E-14	1.58E-15	1.00E-14	5.24E-16	2.08E-16	1.44E-15	9.29E-18	5.65E-14
p,p-DDT	8.56E-18	2.29E-18	9.22E-18	4.61E-19	4.16E-20	3.00E-19	1.86E-21	2.09E-17
Dibenzofuran	5.05E-14	1.02E-14	3.98E-16	3.00E-17	2.66E-16	4.45E-17	1.19E-17	6.14E-14
Dichlorobenzenes (total)	9.09E-17	NA	NA	NA	NA	NA	NA	9.09E-17
1,4-Dichlorobenzene	5.75E-18	NA	NA	NA	NA	NA	NA	5.75E-18
1,1-Dichloroethene	1.41E-16	NA	NA	NA	NA	NA	NA	1.41E-16
1,2-Dichloroethene	9.84E-17	NA	NA	NA	NA	NA	NA	9.84E-17
1,2-Dichloropropane	1.15E-17	NA	NA	NA	NA	NA	NA	1.15E-17
Dieldrin	5.27E-18	1.45E-16	3.95E-18	1.99E-19	2.78E-20	2.01E-20	1.24E-21	1.54E-16
Diisopropyl Methylphosphonate	9.27E-16	2.15E-16	1.39E-19	2.08E-20	3.51E-18	1.27E-19	1.57E-19	1.15E-15
1,3-Dimethylbenzene	1.01E-13	3.03E-14	1.47E-16	1.60E-17	5.32E-16	5.84E-17	2.38E-17	1.32E-13
Dimethyldisulfide	2.57E-15	NA	NA	NA	NA	NA	NA	2.57E-15
Dimethyl Methylphosphonate	2.21E-14	1.18E-14	2.93E-21	4.80E-22	2.76E-18	6.94E-19	1.24E-19	3.39E-14
Dimethylphosphate	6.06E-15	1.98E-16	NE	NE	3.19E-17	NE	1.43E-18	6.29E-15
Dioxins/Furans (EPA TEFs)	1.55E-14	6.82E-16	8.23E-15	1.39E-15	7.67E-17	5.06E-17	3.43E-18	2.59E-14
Dithiane	9.27E-19	7.11E-19	6.65E-23	1.10E-23	4.88E-21	3.36E-23	2.18E-22	1.64E-18
Endrin	5.13E-18	1.80E-19	9.93E-20	6.36E-21	2.51E-20	2.84E-21	1.12E-21	5.45E-18
Ethylbenzene	1.52E-13	NA	NA	NA	NA	NA	NA	1.52E-13
Hexachlorobenzene	1.72E-15	4.49E-16	2.46E-16	1.31E-17	8.07E-18	9.95E-18	3.61E-19	2.45E-15
Hexachlorocyclopentadiene	4.78E-17	1.38E-16	7.50E-18	4.02E-19	2.52E-19	1.57E-20	1.12E-20	1.94E-16
Isodrin	1.35E-17	1.89E-16	2.05E-17	1.02E-18	7.12E-20	4.61E-19	3.18E-21	2.24E-16
Malathion	2.06E-17	2.84E-18	1.85E-20	2.24E-21	1.09E-19	0.00E+00	4.86E-21	2.36E-17
Methanol	5.86E-13	3.18E-12	8.74E-18	1.48E-18	3.09E-15	2.15E-17	1.38E-16	3.77E-12

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Table 8-17
(continued)

Methyl Chloride	5.06E-13	NA	NA	NA	NA	NA	NA	5.06E-13
Methylene Chloride	5.06E-14	NA	NA	NA	NA	NA	NA	5.06E-14
4-Nitrophenol	2.14E-16	7.52E-17	1.97E-19	2.37E-20	1.12E-18	1.10E-19	5.03E-20	2.90E-16
PAHs								
Acenaphthalene	2.53E-13	1.19E-13	1.80E-15	1.39E-16	1.33E-15	2.14E-16	5.95E-17	3.76E-13
Acenaphthene	2.53E-13	5.56E-14	1.34E-15	1.09E-16	1.33E-15	8.31E-17	5.95E-17	3.11E-13
Benzo(a)pyrene	5.05E-14	1.96E-15	6.20E-14	3.05E-15	1.30E-16	2.85E-17	5.82E-18	1.18E-13
Chrysene	5.05E-14	4.82E-15	1.47E-14	7.41E-16	1.48E-16	7.21E-16	6.60E-18	7.16E-14
Dibenzo(a,h)anthracene	5.05E-14	2.35E-15	7.46E-14	3.67E-15	1.54E-16	1.62E-14	6.88E-18	1.47E-13
Fluoranthene	1.52E-13	2.30E-14	1.21E-14	6.37E-16	4.38E-16	NA	1.96E-17	1.88E-13
Fluorene	5.05E-14	1.47E-14	6.76E-16	4.66E-17	2.66E-16	5.95E-17	1.19E-17	6.62E-14
Phenanthrene	1.01E-13	1.18E-14	1.86E-15	1.05E-16	2.38E-16	2.00E-16	1.06E-17	1.15E-13
Pyrene	5.05E-14	6.12E-15	3.65E-15	1.90E-16	1.16E-16	1.64E-16	5.21E-18	6.07E-14
Parathion	2.85E-18	6.49E-19	1.23E-20	1.04E-21	1.50E-20	1.48E-21	6.70E-22	3.53E-18
Pentachlorobenzene	7.71E-16	4.06E-16	4.64E-17	2.66E-18	4.06E-18	NA	1.81E-19	1.23E-15
Phenol	2.74E-12	6.65E-12	4.05E-16	6.41E-17	1.44E-14	4.75E-17	6.44E-16	9.41E-12
Pyridine	2.43E-17	NA	NA	NA	NA	NA	NA	2.43E-17
Quinoline	1.21E-16	8.79E-17	3.42E-20	5.07E-21	6.36E-19	2.76E-20	2.84E-20	2.09E-16
Styrene	5.07E-13	NA	NA	NA	NA	NA	NA	5.07E-13
Supona	8.56E-18	1.98E-18	1.08E-20	1.21E-21	4.50E-20	4.80E-21	2.01E-21	1.06E-17
Tetrachlorobenzene	3.25E-16	3.85E-16	4.27E-18	2.95E-19	1.71E-18	NA	7.65E-20	7.16E-16
Tetrachloroethene	2.01E-15	NA	NA	NA	NA	NA	NA	2.01E-15
Toluene	2.53E-13	NA	NA	NA	NA	NA	NA	2.53E-13
Trichlorobenzene	1.71E-16	2.37E-17	1.02E-18	8.14E-20	9.02E-19	2.16E-19	4.03E-20	1.97E-16
Trichloroethene	3.10E-16	NA	NA	NA	NA	NA	NA	3.10E-16
Urea	3.71E-12	3.23E-10	6.87E-18	1.16E-18	1.95E-14	1.36E-16	8.72E-16	3.27E-10
Vapona	2.28E-17	9.18E-18	3.16E-21	5.03E-22	1.20E-19	1.99E-21	5.37E-21	3.21E-17
Vinyl Chloride	5.06E-13	NA	NA	NA	NA	NA	NA	5.06E-13
Xylene	1.01E-13	NA	NA	NA	NA	NA	NA	1.01E-13
INORGANICS								
Aluminum	6.70E-08	NA	NA	NA	NA	NE	NA	6.70E-08
Ammonia	1.21E-08	NA	NA	NA	NA	NA	NA	1.21E-08
Antimony	2.35E-09	8.20E-11	1.40E-11	2.48E-12	1.24E-11	NA	5.54E-14	2.46E-09
Arsenic	1.33E-08	4.40E-10	5.27E-09	2.79E-11	7.01E-11	3.37E-11	3.13E-13	1.92E-08
Barium	3.26E-09	1.10E-10	7.03E-11	5.01E-13	1.72E-11	NE	7.68E-14	3.46E-09
Beryllium	1.36E-10	4.46E-12	7.04E-15	1.23E-13	7.17E-13	1.73E-14	3.21E-15	1.42E-10
Boron	9.94E-08	NA	NA	NA	NA	NE	NA	9.94E-08
Cadmium	3.88E-10	NA	NA	NA	NA	8.53E-13	NA	3.89E-10
Calcium	5.71E-07	NA	NA	NA	NA	NA	NA	5.71E-07
Chromium (III)	8.85E-10	NA	NA	NA	NA	NA	NA	8.85E-10
Chromium (VI)	3.12E-11	NA	NA	NA	NA	3.23E-14	NA	3.12E-11
Cobalt	2.93E-09	NA	NA	NA	NA	3.92E-13	NA	2.93E-09
Copper	1.25E-05	6.24E-07	1.49E-06	2.42E-07	6.57E-08	1.01E-07	2.94E-10	1.50E-05
Cyanogen	2.43E-17	NA	NA	NA	NA	NA	NA	2.43E-17
Hydrogen Cyanide	2.39E-13	NA	NA	NA	NA	NA	NA	2.39E-13
Iron	1.78E-07	NA	NA	NA	NA	NE	NA	1.78E-07
Lead	4.18E-09	1.39E-10	6.40E-11	1.33E-12	2.20E-11	5.15E-12	9.84E-14	4.41E-09
Lithium	4.09E-10	NA	NA	NA	NA	NE	NA	4.09E-10
Magnesium	5.31E-07	NA	NA	NA	NA	NE	NA	5.31E-07

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Table 8-17
(continued)

Manganese	2.29E-08	NA	NA	NA	NA	NA	NA	2.29E-08
Mercury	3.69E-09	1.73E-10	1.24E-10	1.83E-09	1.94E-11	NA	8.67E-14	5.83E-09
Molybdenum	4.10E-08	NA	NA	NA	NA	NE	NA	4.10E-08
Nickel	1.06E-07	NA	NA	NA	NA	NA	NA	1.06E-07
Phosphate	1.24E-05	NA	NA	NA	NA	NA	NA	1.24E-05
Potassium	4.22E-06	NA	NA	NA	NA	NA	NA	4.22E-06
Selenium	3.42E-05	1.17E-06	9.12E-06	5.87E-07	1.80E-07	3.95E-09	8.04E-10	4.52E-05
Silicon	5.88E-07	NA	NA	NA	NA	NA	NA	5.88E-07
Silver	3.54E-07	1.41E-08	5.20E-07	1.65E-09	1.86E-09	7.80E-09	8.33E-12	9.00E-07
Sodium	4.35E-04	NA	NA	NA	NA	NA	NA	4.35E-04
Strontium	1.36E-10	NA	NA	NA	NA	NE	NA	1.36E-10
Thallium	3.44E-08	1.12E-09	3.93E-09	1.23E-09	1.81E-10	NA	8.09E-13	4.08E-08
Tin	3.00E-08	NA	NA	NA	NA	NE	NA	3.00E-08
Titanium	2.27E-10	NA	NA	NA	NA	NE	NA	2.27E-10
Vanadium	8.69E-09	NA	NA	NA	NA	5.82E-13	NA	8.69E-09
Yittrium	7.95E-11	NA	NA	NA	NA	NE	NA	7.95E-11
Zinc	6.05E-08	NA	NA	NA	NA	2.39E-10	NA	6.07E-08
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	1.75E-05	NA	NA	NA	NA	NA	NA	1.75E-05
Hydrogen Chloride	1.75E-05	NA	NA	NA	NA	NA	NA	1.75E-05
Hydrogen Fluorides	6.19E-07	NA	NA	NA	NA	NA	NA	6.19E-07
Nitric Acid	1.45E-05	NA	NA	NA	NA	NA	NA	1.45E-05
Nitrogen Dioxide	1.20E-04	NA	NA	NA	NA	NA	NA	1.20E-04
Particulate Matter	5.16E-05	NA	NA	NA	NA	NA	NA	5.16E-05
Sulfur Dioxide	9.08E-05	NA	NA	NA	NA	NA	NA	9.08E-05
Sulfuric Acid Mist	3.82E-05	NA	NA	NA	NA	NA	NA	3.82E-05

NA = Not applicable
NE = Not evaluted

Table 8-18

Maximum Total Pollutant Daily Intake for the Infant, Resident-A Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Breast Milk Ingestion	Total
ORGANICS			
Acetone	7.45E-17	1.29E-18	7.58E-17
Acetonitrile	4.52E-15	2.16E-14	2.61E-14
Acrylonitrile	4.52E-16	1.40E-18	4.54E-16
Aldrin	4.79E-17	1.56E-16	2.04E-16
Atrazine	1.06E-17	2.71E-17	3.78E-17
Benzaldehyde	9.82E-13	2.60E-12	3.58E-12
Benzene	9.68E-13	1.12E-15	9.70E-13
Benzofuran	1.88E-12	4.88E-12	6.77E-12
Benzoic Acid	4.76E-13	1.24E-12	1.71E-12
Benzonitrile	4.52E-16	1.19E-15	1.64E-15
Biphenyl	4.72E-13	1.16E-12	1.63E-12
Bromomethane	9.43E-14	1.64E-15	9.60E-14
Carbazole	9.05E-17	2.32E-16	3.23E-16
Carbon Tetrachloride	3.00E-16	5.21E-18	3.06E-16
Chlorobenzene	2.33E-13	4.04E-15	2.37E-13
4-Chlorobiphenyl	5.47E-13	1.39E-12	1.94E-12
4,4-Chlorobiphenyl	7.16E-15	1.82E-14	2.54E-14
Chloroform	4.76E-17	8.26E-19	4.84E-17
4-Chlorophenylmethylsulfone	1.75E-16	4.57E-16	6.32E-16
4-Chlorophenylmethylsulfoxide	6.51E-16	1.70E-15	2.35E-15
p,p-DDE	7.97E-14	1.84E-13	2.64E-13
p,p-DDT	1.60E-17	1.88E-17	3.47E-17
Dibenzofuran	9.41E-14	2.40E-13	3.34E-13
Dichlorobenzenes (total)	1.70E-16	2.94E-18	1.73E-16
1,4-Dichlorobenzene	1.07E-17	1.86E-19	1.09E-17
1,1-Dichloroethene	2.64E-16	4.58E-18	2.68E-16
1,2-Dichloroethene	1.83E-16	3.19E-18	1.87E-16
1,2-Dichloropropane	2.14E-17	3.71E-19	2.17E-17
Dieldrin	9.84E-18	5.80E-17	6.78E-17
Diisopropyl Methylphosphonate	1.73E-15	4.48E-15	6.21E-15
1,3-Dimethylbenzene	1.88E-13	4.84E-13	6.73E-13
Dimethyldisulfide	4.79E-15	1.18E-14	1.66E-14
Dimethyl Methylphosphonate	4.12E-14	1.13E-13	1.54E-13
Dimethylphosphate	1.13E-14	2.86E-14	3.99E-14
Dioxins/Furans (EPA TEFs)	2.89E-14	5.85E-13	6.14E-13
Dithiane	1.73E-18	4.86E-18	6.59E-18
Endrin	9.57E-18	2.42E-17	3.38E-17
Ethylbenzene	2.83E-13	4.91E-15	2.88E-13
Hexachlorobenzene	3.22E-15	1.86E-15	5.07E-15
Hexachlorocyclopentadiene	8.91E-17	2.57E-16	3.46E-16
Isodrin	2.52E-17	1.08E-16	1.33E-16
Malathion	3.85E-17	9.83E-17	1.37E-16
Methanol	1.09E-12	5.27E-12	6.37E-12
Methyl Chloride	9.43E-13	1.64E-14	9.60E-13
Methylene Chloride	9.43E-14	1.64E-15	9.60E-14
4-Nitrophenol	3.99E-16	1.03E-15	1.43E-15
PAHs			
Acenaphthalene	4.72E-13	1.22E-12	1.69E-12
Acenaphthene	4.72E-13	1.20E-12	1.68E-12
Benzo(a)pyrene	9.41E-14	2.40E-13	3.34E-13
Chrysene	9.41E-14	2.40E-13	3.35E-13
Dibenzo(a,h)anthracene	9.41E-14	2.67E-13	3.61E-13
Fluoranthene	2.83E-13	7.20E-13	1.00E-12
Fluorene	9.41E-14	2.41E-13	3.35E-13
Phenanthrene	1.88E-13	4.79E-13	6.67E-13
Pyrene	9.41E-14	2.39E-13	3.34E-13
Parathion	5.31E-18	1.36E-17	1.89E-17
Pentachlorobenzene	1.44E-15	8.40E-16	2.28E-15
Phenol	5.10E-12	1.04E-13	5.21E-12
Pyridine	4.52E-17	1.11E-16	1.57E-16
Quinoline	2.25E-16	5.97E-16	8.22E-16
Styrene	9.45E-13	1.64E-14	9.62E-13

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Table 8-18
(continued)

Supona	1.60E-17	4.09E-17	5.68E-17
Tetrachlorobenzene	6.06E-16	3.65E-16	9.72E-16
Tetrachloroethene	3.75E-15	6.52E-17	3.82E-15
Toluene	4.72E-13	1.36E-15	4.73E-13
Trichlorobenzene	3.20E-16	1.83E-16	5.03E-16
Trichloroethene	5.78E-16	1.00E-17	5.88E-16
Urea	6.91E-12	2.91E-10	2.98E-10
Vapona	4.25E-17	1.13E-16	1.56E-16
Vinyl Chloride	9.43E-13	1.64E-14	9.60E-13
Xylene	1.88E-13	1.09E-16	1.89E-13
INORGANICS			
Aluminum	1.25E-07	NE	1.25E-07
Ammonia	2.25E-08	NE	2.25E-08
Antimony	4.39E-09	NE	4.39E-09
Arsenic	2.48E-08	NE	2.48E-08
Barium	6.08E-09	NE	6.08E-09
Beryllium	2.54E-10	NE	2.54E-10
Boron	1.85E-07	NE	1.85E-07
Cadmium	7.24E-10	NE	7.24E-10
Calcium	1.06E-06	NE	1.06E-06
Chromium (III)	1.65E-09	NE	1.65E-09
Chromium (VI)	5.81E-11	NE	5.81E-11
Cobalt	5.47E-09	NE	5.47E-09
Copper	2.33E-05	NE	2.33E-05
Cyanogen	4.52E-17	NE	4.52E-17
Hydrogen Cyanide	4.47E-13	NE	4.47E-13
Iron	3.31E-07	NE	3.31E-07
Lead	7.80E-09	NE	7.80E-09
Lithium	7.62E-10	NE	7.62E-10
Magnesium	9.90E-07	NE	9.90E-07
Manganese	4.27E-08	NE	4.27E-08
Mercury	6.87E-09	NE	6.87E-09
Molybdenum	7.64E-08	NE	7.64E-08
Nickel	1.98E-07	NE	1.98E-07
Phosphate	2.31E-05	NE	2.31E-05
Potassium	7.87E-06	NE	7.87E-06
Selenium	6.37E-05	NE	6.37E-05
Silicon	1.10E-06	NE	1.10E-06
Silver	6.60E-07	NE	6.60E-07
Sodium	8.11E-04	NE	8.11E-04
Strontium	2.54E-10	NE	2.54E-10
Thallium	6.41E-08	NE	6.41E-08
Tin	5.60E-08	NE	5.60E-08
Titanium	4.24E-10	NE	4.24E-10
Vanadium	1.62E-08	NE	1.62E-08
Yittrium	1.48E-10	NE	1.48E-10
Zinc	1.13E-07	NE	1.13E-07
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	3.27E-05	NE	3.27E-05
Hydrogen Chloride	3.27E-05	NA	3.27E-05
Hydrogen Fluorides	1.16E-06	NA	1.16E-06
Nitric Acid	2.70E-05	NA	2.70E-05
Nitrogen Dioxide	2.23E-04	NA	2.23E-04
Particulate Matter	9.63E-05	NA	9.63E-05
Sulfur Dioxide	1.69E-04	NA	1.69E-04
Sulfuric Acid Mist	7.12E-05	NA	7.12E-05

NA = Not applicable
NE = Not evaluted

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Table 8-19

Maximum Total Pollutant Daily Intake for Infant, Resident-B Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Breast Milk Ingestion	Total
ORGANICS			
Acetone	1.17E-17	2.03E-19	1.19E-17
Acetonitrile	7.08E-16	1.65E-14	1.72E-14
Acrylonitrile	7.08E-17	2.19E-19	7.11E-17
Aldrin	7.51E-18	6.40E-17	7.15E-17
Atrazine	1.67E-18	4.53E-18	6.19E-18
Benzaldehyde	1.54E-13	5.57E-13	7.10E-13
Benzene	1.52E-13	1.75E-16	1.52E-13
Benzofuran	2.95E-13	9.17E-13	1.21E-12
Benzoic Acid	7.45E-14	2.41E-13	3.15E-13
Benzonitrile	7.08E-17	2.50E-16	3.20E-16
Biphenyl	7.39E-14	1.82E-13	2.56E-13
Bromomethane	1.48E-14	2.56E-16	1.50E-14
Carbazole	1.42E-17	4.09E-17	5.50E-17
Carbon Tetrachloride	4.70E-17	8.16E-19	4.78E-17
Chlorobenzene	3.65E-14	6.33E-16	3.71E-14
4-Chlorobiphenyl	8.56E-14	2.30E-13	3.16E-13
4,4-Chlorobiphenyl	1.12E-15	2.99E-15	4.11E-15
Chloroform	7.45E-18	1.29E-19	7.58E-18
4-Chlorophenylmethylsulfone	2.74E-17	9.11E-17	1.18E-16
4-Chlorophenylmethylsulfoxide	1.02E-16	3.32E-16	4.33E-16
p,p-DDE	1.25E-14	3.10E-14	4.35E-14
p,p-DDT	2.50E-18	3.52E-18	6.02E-18
Dibenzofuran	1.47E-14	4.05E-14	5.53E-14
Dichlorobenzenes (total)	2.66E-17	4.61E-19	2.70E-17
1,4-Dichlorobenzene	1.68E-18	2.91E-20	1.71E-18
1,1-Dichloroethene	4.13E-17	7.17E-19	4.20E-17
1,2-Dichloroethene	2.87E-17	4.99E-19	2.92E-17
1,2-Dichloropropane	3.35E-18	5.81E-20	3.40E-18
Dieldrin	1.54E-18	5.17E-17	5.32E-17
Diisopropyl Methylphosphonate	2.71E-16	8.43E-16	1.11E-15
1,3-Dimethylbenzene	2.95E-14	8.58E-14	1.15E-13
Dimethyldisulfide	7.51E-16	1.85E-15	2.60E-15
Dimethyl Methylphosphonate	6.45E-15	2.94E-14	3.59E-14
Dimethylphosphate	1.77E-15	4.48E-15	6.25E-15
Dioxins/Furans (EPA TEFs)	4.52E-15	9.50E-14	9.95E-14
Dithiane	2.71E-19	1.40E-18	1.67E-18
Endrin	1.50E-18	3.82E-18	5.32E-18
Ethylbenzene	4.43E-14	7.69E-16	4.51E-14
Hexachlorobenzene	5.03E-16	3.23E-16	8.26E-16
Hexachlorocyclopentadiene	1.40E-17	8.07E-17	9.47E-17
Isodrin	3.95E-18	7.34E-17	7.74E-17
Malathion	6.03E-18	1.66E-17	2.27E-17
Methanol	1.71E-13	4.06E-12	4.23E-12
Methyl Chloride	1.48E-13	2.56E-15	1.50E-13
Methylene Chloride	1.48E-14	2.56E-16	1.50E-14
4-Nitrophenol	6.24E-17	1.87E-16	2.50E-16
PAHs			
Acenaphthalene	7.39E-14	2.26E-13	3.00E-13
Acenaphthene	7.39E-14	2.05E-13	2.79E-13
Benzo(a)pyrene	1.47E-14	3.96E-14	5.43E-14
Chrysene	1.47E-14	4.00E-14	5.47E-14
Dibenzo(a,h)anthracene	1.47E-14	6.62E-14	8.09E-14
Fluoranthene	4.43E-14	1.18E-13	1.63E-13
Fluorene	1.47E-14	4.20E-14	5.67E-14
Phenanthrene	2.95E-14	7.79E-14	1.07E-13
Pyrene	1.47E-14	3.91E-14	5.39E-14
Parathion	8.32E-19	2.32E-18	3.15E-18
Pentachlorobenzene	2.25E-16	1.58E-16	3.83E-16
Phenol	7.99E-13	3.36E-14	8.32E-13
Pyridine	7.08E-18	1.74E-17	2.45E-17
Quinoline	3.53E-17	1.29E-16	1.64E-16
Styrene	1.48E-13	2.57E-15	1.51E-13

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Table 8-19
(continued)

Supona	2.50E-18	7.10E-18	9.60E-18
Tetrachlorobenzene	9.50E-17	8.24E-17	1.77E-16
Tetrachloroethene	5.88E-16	1.02E-17	5.98E-16
Toluene	7.39E-14	2.14E-16	7.41E-14
Trichlorobenzene	5.00E-17	3.03E-17	8.03E-17
Trichloroethene	9.04E-17	1.57E-18	9.20E-17
Urea	1.08E-12	3.98E-10	3.99E-10
Vapona	6.66E-18	2.48E-17	3.15E-17
Vinyl Chloride	1.48E-13	2.56E-15	1.50E-13
Xylene	2.95E-14	1.71E-17	2.95E-14
INORGANICS			
Aluminum	1.96E-08	NE	1.96E-08
Ammonia	3.53E-09	NE	3.53E-09
Antimony	6.87E-10	NE	6.87E-10
Arsenic	3.89E-09	NE	3.89E-09
Barium	9.53E-10	NE	9.53E-10
Beryllium	3.98E-11	NE	3.98E-11
Boron	2.90E-08	NE	2.90E-08
Cadmium	1.13E-10	NE	1.13E-10
Calcium	1.67E-07	NE	1.67E-07
Chromium (III)	2.59E-10	NE	2.59E-10
Chromium (VI)	9.10E-12	NE	9.10E-12
Cobalt	8.56E-10	NE	8.56E-10
Copper	3.65E-06	NE	3.65E-06
Cyanogen	7.08E-18	NE	7.08E-18
Hydrogen Cyanide	6.99E-14	NE	6.99E-14
Iron	5.19E-08	NE	5.19E-08
Lead	1.22E-09	NE	1.22E-09
Lithium	1.19E-10	NE	1.19E-10
Magnesium	1.55E-07	NE	1.55E-07
Manganese	6.69E-09	NE	6.69E-09
Mercury	1.08E-09	NE	1.08E-09
Molybdenum	1.20E-08	NE	1.20E-08
Nickel	3.11E-08	NE	3.11E-08
Phosphate	3.62E-06	NE	3.62E-06
Potassium	1.23E-06	NE	1.23E-06
Selenium	9.98E-06	NE	9.98E-06
Silicon	1.72E-07	NE	1.72E-07
Silver	1.03E-07	NE	1.03E-07
Sodium	1.27E-04	NE	1.27E-04
Strontium	3.98E-11	NE	3.98E-11
Thallium	1.00E-08	NE	1.00E-08
Tin	8.77E-09	NE	8.77E-09
Titanium	6.63E-11	NE	6.63E-11
Vanadium	2.54E-09	NE	2.54E-09
Yittrium	2.32E-11	NE	2.32E-11
Zinc	1.77E-08	NE	1.77E-08
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	5.12E-06	NE	5.12E-06
Hydrogen Chloride	5.12E-06	NA	5.12E-06
Hydrogen Fluorides	1.81E-07	NA	1.81E-07
Nitric Acid	4.22E-06	NA	4.22E-06
Nitrogen Dioxide	3.50E-05	NA	3.50E-05
Particulate Matter	1.51E-05	NA	1.51E-05
Sulfur Dioxide	2.65E-05	NA	2.65E-05
Sulfuric Acid Mist	1.12E-05	NA	1.12E-05

NA = Not applicable
NE = Not evaluted

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Table 8-20

Maximum Total Pollutant Daily Intake for Infant, Farmer Scenario

Pollutant	Daily Intake (mg/kg/day) Inhalation	Breast Milk Ingestion	Total
ORGANICS			
Acetone	2.61E-17	4.54E-19	2.66E-17
Acetonitrile	1.59E-15	5.08E-14	5.24E-14
Acrylonitrile	1.59E-16	4.90E-19	1.59E-16
Aldrin	1.68E-17	4.31E-16	4.48E-16
Atrazine	3.74E-18	1.08E-17	1.45E-17
Benzaldehyde	3.45E-13	1.19E-12	1.54E-12
Benzene	3.40E-13	3.93E-16	3.40E-13
Benzofuran	6.61E-13	2.35E-12	3.01E-12
Benzoic Acid	1.67E-13	5.37E-13	7.04E-13
Benzonitrile	1.59E-16	5.39E-16	6.98E-16
Biphenyl	1.66E-13	4.08E-13	5.73E-13
Bromomethane	3.31E-14	5.75E-16	3.37E-14
Carbazole	3.18E-17	1.02E-16	1.34E-16
Carbon Tetrachloride	1.05E-16	1.83E-18	1.07E-16
Chlorobenzene	8.17E-14	1.42E-15	8.32E-14
4-Chlorobiphenyl	1.92E-13	5.62E-13	7.53E-13
4,4-Chlorobiphenyl	2.51E-15	7.55E-15	1.01E-14
Chloroform	1.67E-17	2.90E-19	1.70E-17
4-Chlorophenylmethylsulfone	6.13E-17	1.93E-16	2.54E-16
4-Chlorophenylmethylsulfoxide	2.28E-16	7.25E-16	9.54E-16
p,p-DDE	2.80E-14	7.35E-14	1.01E-13
p,p-DDT	5.60E-18	1.12E-17	1.68E-17
Dibenzofuran	3.30E-14	9.96E-14	1.33E-13
Dichlorobenzenes (total)	5.95E-17	1.03E-18	6.05E-17
1,4-Dichlorobenzene	3.76E-18	6.53E-20	3.83E-18
1,1-Dichloroethene	9.26E-17	1.61E-18	9.42E-17
1,2-Dichloroethene	6.44E-17	1.12E-18	6.55E-17
1,2-Dichloropropane	7.50E-18	1.30E-19	7.63E-18
Dieldrin	3.45E-18	2.56E-16	2.60E-16
Diisopropyl Methylphosphonate	6.07E-16	1.87E-15	2.48E-15
1,3-Dimethylbenzene	6.61E-14	2.16E-13	2.82E-13
Dimethyldisulfide	1.68E-15	4.14E-15	5.82E-15
Dimethyl Methylphosphonate	1.45E-14	5.59E-14	7.04E-14
Dimethylphosphate	3.97E-15	1.02E-14	1.41E-14
Dioxins/Furans (EPA TEFs)	1.01E-14	2.61E-13	2.71E-13
Dithiane	6.07E-19	2.72E-18	3.32E-18
Endrin	3.36E-18	8.71E-18	1.21E-17
Ethylbenzene	9.93E-14	1.72E-15	1.01E-13
Hexachlorobenzene	1.13E-15	8.45E-16	1.97E-15
Hexachlorocyclopentadiene	3.13E-17	3.17E-16	3.48E-16
Isodrin	8.85E-18	3.56E-16	3.65E-16
Malathion	1.35E-17	3.83E-17	5.19E-17
Methanol	3.84E-13	6.37E-12	6.76E-12
Methyl Chloride	3.31E-13	5.75E-15	3.37E-13
Methylene Chloride	3.31E-14	5.75E-16	3.37E-14
4-Nitrophenol	1.40E-16	4.75E-16	6.14E-16
PAHs			
Acenaphthalene	1.66E-13	6.14E-13	7.80E-13
Acenaphthene	1.66E-13	5.06E-13	6.71E-13
Benzo(a)pyrene	3.30E-14	1.29E-13	1.62E-13
Chrysene	3.30E-14	1.02E-13	1.35E-13
Dibenzo(a,h)anthracene	3.30E-14	1.64E-13	1.97E-13
Fluoranthene	9.93E-14	2.94E-13	3.93E-13
Fluorene	3.30E-14	1.07E-13	1.40E-13
Phenanthrene	6.61E-14	1.86E-13	2.52E-13
Pyrene	3.30E-14	9.51E-14	1.28E-13
Parathion	1.86E-18	5.74E-18	7.60E-18
Pentachlorobenzene	5.05E-16	4.45E-16	9.50E-16
Phenol	1.79E-12	1.11E-13	1.90E-12
Pyridine	1.59E-17	3.91E-17	5.50E-17
Quinoline	7.90E-17	3.45E-16	4.24E-16
Styrene	3.32E-13	5.76E-15	3.37E-13

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Table 8-20
(continued)

Supona	5.60E-18	1.73E-17	2.29E-17
Tetrachlorobenzene	2.13E-16	2.67E-16	4.79E-16
Tetrachloroethene	1.32E-15	2.29E-17	1.34E-15
Toluene	1.66E-13	4.79E-16	1.66E-13
Trichlorobenzene	1.12E-16	7.20E-17	1.84E-16
Trichloroethene	2.03E-16	3.52E-18	2.06E-16
Urea	2.43E-12	5.58E-10	5.61E-10
Vapona	1.49E-17	5.27E-17	6.76E-17
Vinyl Chloride	3.31E-13	5.75E-15	3.37E-13
Xylene	6.61E-14	3.83E-17	6.62E-14
INORGANICS			
Aluminum	4.38E-08	NE	4.38E-08
Ammonia	7.90E-09	NE	7.90E-09
Antimony	1.54E-09	NE	1.54E-09
Arsenic	8.71E-09	NE	8.71E-09
Barium	2.13E-09	NE	2.13E-09
Beryllium	8.92E-11	NE	8.92E-11
Boron	6.51E-08	NE	6.51E-08
Cadmium	2.54E-10	NE	2.54E-10
Calcium	3.74E-07	NE	3.74E-07
Chromium (III)	5.79E-10	NE	5.79E-10
Chromium (VI)	2.04E-11	NE	2.04E-11
Cobalt	1.92E-09	NE	1.92E-09
Copper	8.17E-06	NE	8.17E-06
Cyanogen	1.59E-17	NE	1.59E-17
Hydrogen Cyanide	1.57E-13	NE	1.57E-13
Iron	1.16E-07	NE	1.16E-07
Lead	2.74E-09	NE	2.74E-09
Lithium	2.68E-10	NE	2.68E-10
Magnesium	3.47E-07	NE	3.47E-07
Manganese	1.50E-08	NE	1.50E-08
Mercury	2.41E-09	NE	2.41E-09
Molybdenum	2.68E-08	NE	2.68E-08
Nickel	6.96E-08	NE	6.96E-08
Phosphate	8.11E-06	NE	8.11E-06
Potassium	2.76E-06	NE	2.76E-06
Selenium	2.24E-05	NE	2.24E-05
Silicon	3.85E-07	NE	3.85E-07
Silver	2.32E-07	NE	2.32E-07
Sodium	2.84E-04	NE	2.84E-04
Strontium	8.92E-11	NE	8.92E-11
Thallium	2.25E-08	NE	2.25E-08
Tin	1.97E-08	NE	1.97E-08
Titanium	1.49E-10	NE	1.49E-10
Vanadium	5.69E-09	NE	5.69E-09
Yittrium	5.20E-11	NE	5.20E-11
Zinc	3.96E-08	NE	3.96E-08
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	1.15E-05	NE	1.15E-05
Hydrogen Chloride	1.15E-05	NA	1.15E-05
Hydrogen Fluorides	4.05E-07	NA	4.05E-07
Nitric Acid	9.46E-06	NA	9.46E-06
Nitrogen Dioxide	7.84E-05	NA	7.84E-05
Particulate Matter	3.38E-05	NA	3.38E-05
Sulfur Dioxide	5.94E-05	NA	5.94E-05
Sulfuric Acid Mist	2.50E-05	NA	2.50E-05

NA = Not applicable
NE = Not evaluted

SECTION 8

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SECTION 9

TOXICITY ASSESSMENT

9.1 INTRODUCTION

The purpose of the human health toxicity assessment is to assign "toxicity values" to each pollutant evaluated in a human health risk assessment. The toxicity values are then used in combination with the potential dose to which a human could be exposed (Section 8) to evaluate the potential human health risks associated with the pollutant (Section 10). Where available, current human health toxicity values developed by the EPA (cancer slope factors and reference doses) have been used. If EPA toxicity values were not available, toxicity values derived in EPA-approved risk assessments were utilized. Finally, if values could not be found in these documents, the toxicity values were derived from existing toxicity information or health-based standards using procedures established by EPA (EPA, 1990) or WESTON.

Based on emissions from test burns conducted by T-Thermal, Inc., in Conshohocken, Pennsylvania, and waste stream data from the RMA site, a list of chemicals to be evaluated was established (Section 5). These chemicals were then screened in the pollutant/pathways analysis (Section 7). Based on the specific pathways to which each chemical was assigned, the route-specific toxicity criteria was determined.

9.2 CARCINOGENIC AND NONCARCINOGENIC RISK-BASED TOXICITY VALUES

In evaluating potential health risks, both carcinogenic and noncarcinogenic health effects must be considered. The potential for producing carcinogenic effects is limited to substances that have been shown to be carcinogenic in animals and/or humans. Excessive exposure to all pollutants, carcinogens and noncarcinogens, can produce adverse noncarcinogenic health effects. Therefore, it is necessary to identify and select noncancer toxicity values (reference doses) for each contaminant selected for evaluation and to identify

and select cancer toxicity values (cancer slope factors) for those chemicals that show evidence of carcinogenic activity.

9.2.1 Carcinogenic Risk-Based Toxicity Values

The toxicity values that were used in the evaluation of carcinogenic risks in Section 10 are carcinogenic slope factors developed by EPA (1990). It is assumed by EPA in developing carcinogenic slope factors that the risk of cancer is linearly related to dose. This means that even if all of the cancer data obtained from laboratory animals or epidemiological studies are for relatively high doses, it is conservatively assumed that these high doses can be extrapolated down to extremely small doses, with some incremental risk of cancer always remaining. Figure 9-1 illustrates this approach. This "nonthreshold" theory assumes that even a small number of molecules (possibly a single molecule) of a carcinogen may cause changes in a single cell that could result in the cell dividing in an uncontrolled manner and eventually lead to cancer. The slope factors are usually derived by EPA using a linearized multistage model and reflect the upper-bound limit of the cancer potency of any chemical. As a result, the calculated carcinogenic risk is likely to represent a plausible upper limit to the risk. The actual risk is unknown, but is likely to be lower than the predicted risk, and may be even as low as zero (EPA, 1986a; 1989).

There is some dispute as to whether the extrapolation from high to low doses is a realistic approach. It has been argued that at low doses cells may have the ability to detoxify carcinogens or repair cellular damage. Although it is important to recognize the possibility that some carcinogens may have a threshold for toxicity, this argument is not relevant to this analysis. It is important that this risk assessment use the same EPA approach to calculating carcinogenic risk as other risk assessments. In this way, predicted risks for all scenarios and for all sites can be compared.

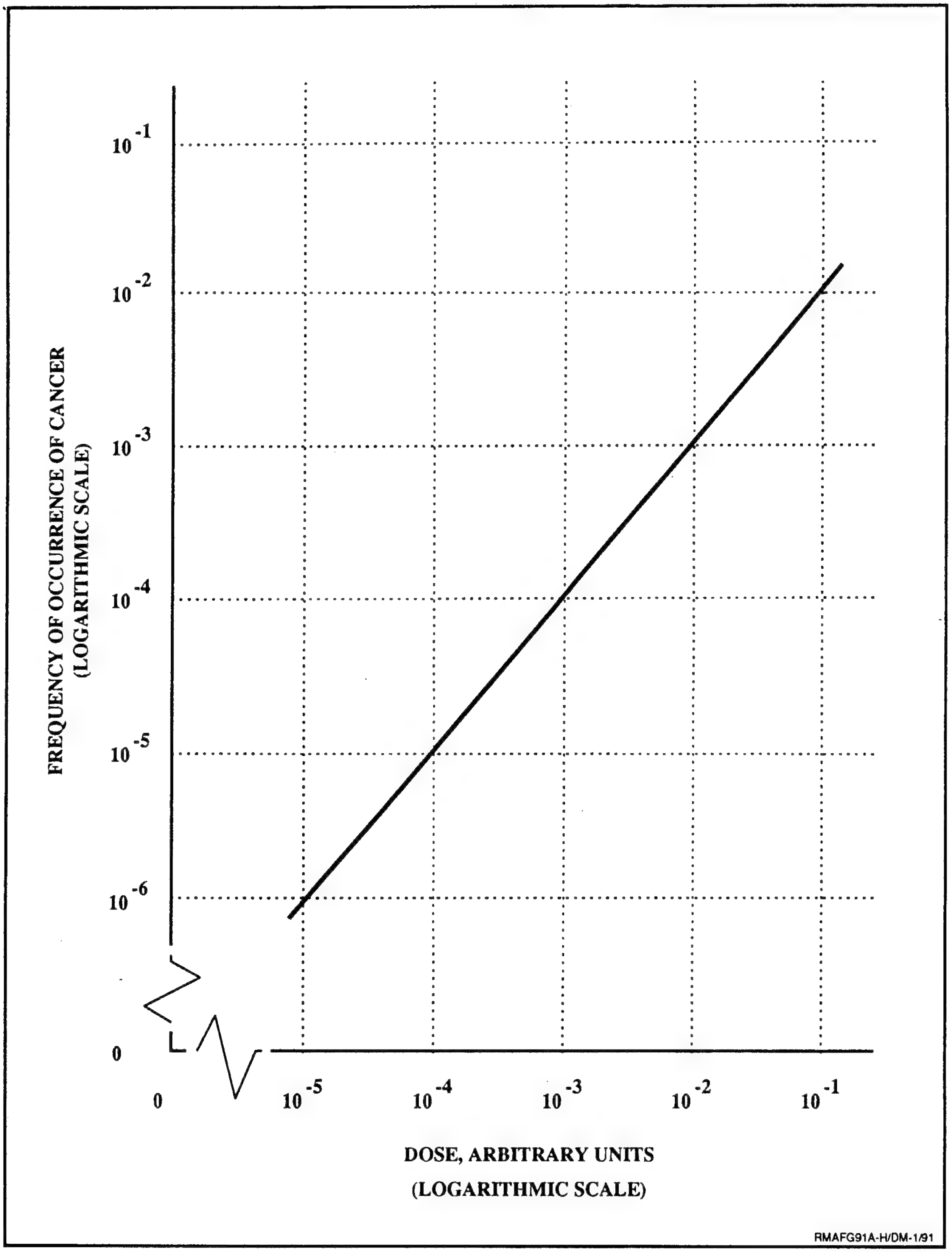


FIGURE 9-1 HYPOTHETICAL DOSE-RESPONSE CURVE FOR A "NO THRESHOLD" OR CARCINOGENIC CHEMICAL

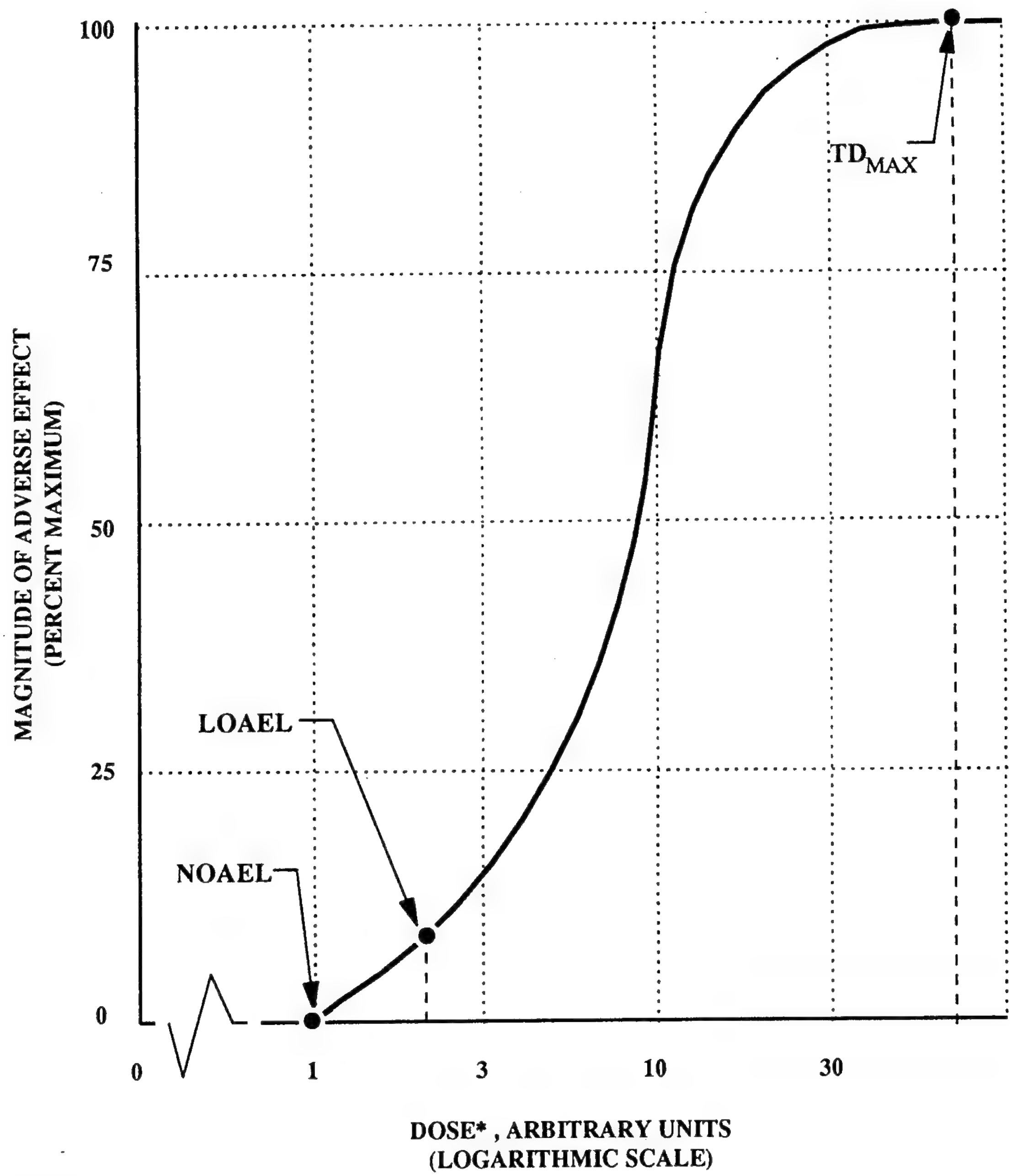
9.2.2 Noncarcinogenic Risk-Based Toxicity Values

The toxicity values used to evaluate the potential for noncarcinogenic health effects are generically referred to in this document as reference doses (RfDs). Unlike the approach used in evaluating carcinogenic risk, it is assumed that a threshold dose exists below which there is no potential for toxicity. The term RfD was developed by EPA to refer to a daily intake of a chemical to which an individual can be exposed without any expectation of noncarcinogenic adverse health effects occurring (e.g., organ damage, biochemical alterations, birth defects). The term is used in this assessment to apply to any established or derived toxicity value fitting this description. In general terms, the RfD is derived from a NOAEL (no-observed-adverse-effect level) or LOAEL (lowest-observed-adverse-effect level) obtained from animal studies by the application of standard order-of-magnitude uncertainty factors, and in certain cases, an additional modifying factor to account for professional assessment of scientific uncertainties in the available data (EPA, 1989).

A "no-observed-adverse-effect level" (NOAEL) is that dose of chemical at which no toxic effects are observed in any of the test subjects. The study chosen to establish the NOAEL is based on the criterion that the measured toxic endpoint represents the most sensitive target organ or tissue (i.e., critical organ) to that chemical. Since many chemicals can produce toxic effects on several organ systems, with each toxic effect possibly having a separate threshold dose, the distinction of the "critical" toxic effect provides added confidence that the NOAEL is protective of human health. Figure 9-2 illustrates this threshold theory. A variety of regulatory agencies have used the threshold approach for noncarcinogenic substances in the development of health effects criteria, such as worker-related threshold limit values (TLVs), air quality standards, FDA food additive regulations, and drinking water regulations.

9.3 CANCER SLOPE FACTORS

With the exceptions of lead and parathion, all chemicals in the study that have evidence of carcinogenicity in animals and/or humans and are classified as carcinogens by EPA (Groups



KEY:

NOAEL = *No-observed-adverse-effect level for critical target organ*

LOAEL = *Lowest-observed-adverse-effect level for critical target organ*

TD_{MAX} = *Dose at which toxic response is maximum*

*DOSE = *Usually expressed in mg chemical per Kg bodyweight of test animal*

RMAFG92A-H/DM-1/91

FIGURE 9-2 HYPOTHETICAL DOSE-RESPONSE CURVE FOR A "THRESHOLD" OR NONCARCINOGENIC CHEMICAL

A, B, or C) and/or the International Agency for Research on Cancer (IARC) (Groups 1, 2A, or 2B) were evaluated for potential carcinogenic risk (CIS, 1988; EPA, 1990). The chemicals that have been categorized as carcinogens and their EPA and IARC carcinogenicity classifications are presented in Table 9-1. An explanation of the EPA and IARC carcinogenicity classification systems is presented in Table 9-2.

Although lead is classified by the EPA (1990) as a carcinogen (Group B2), EPA recommends that its carcinogenicity not be quantitated for the purpose of risk assessment because of the uncertainty of its carcinogenic potency. In addition, EPA has stated that lead does not appear to be a potent carcinogen and that at low doses "the non-cancer effects of lead are of greatest concern for regulatory purposes" (EPA, 1988). There are currently no EPA-derived slope factors for lead. In the absence of a slope factor for lead, it was not included in the evaluation of potential cancer risk.

The potential cancer risk posed by polycyclic aromatic hydrocarbons (PAHs) was evaluated using the conservative traditional EPA approach, which assumes that all carcinogenic PAHs have the potency of benzo(a)pyrene (EPA, 1986a). EPA is currently re-evaluating the slope factors for benzo(a)pyrene. In the absence of published revised values, the previously developed factor (EPA, 1986b) was used.

9.3.1 Oral Route

The carcinogenic potency of a chemical depends on its route of entry into the body. In some cases, a carcinogen may produce tumors only at or near a specific natural route of entry (e.g., nasal passages) and may not be carcinogenic through other exposure routes. This applies to several of the evaluated inorganic pollutants, including cadmium, chromium VI, and nickel (EPA, 1990). Therefore, cancer risk was not calculated for these metals through the oral route. Oral slope factors, expressed in units of $(mg/kg/day)^{-1}$ and/or unit risk factors, expressed in units of $(\mu g/L)^{-1}$, were available for the remaining evaluated carcinogens. A slope factor was calculated from the unit risk factor in accordance with EPA guidance (EPA, 1990) if a slope factor was unavailable.

9.3.2 Inhalation Route

The carcinogenic potency of inhalation carcinogens can be presented as a slope factor expressed in units of $(mg/kg/day)^{-1}$, or as a unit risk factor expressed in units of $(\mu g/m^3)^{-1}$. These values can be interconverted in accordance with EPA guidance by taking into consideration the inhalation of 20 m^3 of air/day and a body weight of 70 kg (EPA, 1990). In Section 10, the potency of inhalation carcinogens expressed as the slope factor [i.e., $(mg/kg/day)^{-1}$] was used in conjunction with the estimated daily intakes, calculated as administered dose, in estimating cancer risk.

Inhalation slope factors were available for some of the carcinogens selected for evaluation (EPA 1990). For the few organics for which an inhalation slope factor was unavailable, the oral slope factor was used to evaluate the inhalation pathway. For dioxins/furans (as 2,3,7,8-TCDD) it was necessary to modify the slope factor presented by EPA, and for arsenic it was necessary to recalculate an inhalation slope factor from the unit risk factor.

Both the unit risk factor and slope factor for 2,3,7,8-TCDD were derived by EPA from the oral slope factor. In developing the unit risk factor, EPA has incorporated a factor of 0.75 to account for the fraction of inhaled particles retained in the body. The agency, however, did not adjust the inhalation slope factor (EPA, 1985; EPA, 1990). Because the fraction of inhaled particles is not taken into account elsewhere in the report, to be consistent with the approach used in developing the unit risk factor, the inhalation slope factor for 2,3,7,8-TCDD (EPA, 1990) also was adjusted (i.e., multiplied) by a factor of 0.75.

Although an inhalation slope factor was available for arsenic, the factor reflects the potency of the absorbed dose (EPA, 1990). In this evaluation, the dosages that were calculated for the inhalation pathway were expressed as an administered dose. Therefore, an inhalation slope factor for arsenic was derived from the unit risk factor, which expresses the potency of the administered dose.

9.3.3 Dermal Route

Although few data are available concerning the carcinogenic activity of chemicals that are systemically absorbed through dermal exposure, it is assumed that all of the chemicals that are carcinogenic through the oral route are potentially carcinogenic through the dermal route. Those chemicals that are categorized as being carcinogenic through the inhalation route only (i.e., cadmium, chromium, nickel) were not addressed. As discussed in Subsection 9.3.1, these metals cause tumors at the site of exposure (i.e., respiratory tract). There are inadequate data to associate these chemicals with systemic tumors as a result of exposure through other natural exposure routes (i.e., oral or dermal).

In the absence of dermal slope factors for all of the carcinogens, a dermal slope factor was derived for each chemical in accordance with EPA guidance by dividing its respective oral slope factor by an appropriate gastrointestinal absorption factor (EPA, 1989). As a result, each dermal slope factor represents the potency of the absorbed dermal dose. This is consistent with the approach described in Subsection 9.4.3 for calculating intake through dermal exposure in which the estimated daily intake was expressed as an absorbed dermal dose.

Ideally, each oral slope factor should be adjusted by a gastrointestinal absorption factor that corresponds specifically to the test species/strain and the vehicle that were used in the studies on which the oral slope factor was based. These data were either lacking for most of the chemicals or were, at best, limited. Therefore, assumptions were made regarding the gastrointestinal absorption of each of the chemicals, depending on their general chemical classification: volatile organic, semi-volatile organic, or inorganic. The assumptions were based on available information for substances that fall into these categories and are expected to be conservative. Gastrointestinal absorption factors of 90 percent (0.90), 50 percent (0.50), and 5 percent (0.05) were assumed for volatile organics, semi-volatile organics, and inorganics, respectively. It should be noted that the lower the gastrointestinal absorption factor, the more conservative the toxicity value becomes.

Oral toxicity values for volatile organics are commonly based on data from oral studies in which the agent is administered in drinking water or by gavage, or are extrapolated from inhalation toxicity studies. Absorption through these routes would be expected to be close to or at 100 percent. Assuming the possibility of less than total absorption, a gastrointestinal absorption factor of 0.90 was used for volatile organics. Oral toxicity values for semi-volatile organics are usually derived from oral studies in which the agent is administered in the diet, by gavage or by capsule. In a few cases, they may also be developed from inhalation data. Semi-volatile organics are also expected to be well absorbed (i.e., 50 percent or greater). A gastrointestinal absorption factor of 50 percent was assumed for the semi-volatiles. This value probably best approximates absorption through dietary exposure and is likely to be conservative for the other vehicles (i.e., gavage and capsule). Metals, in general, tend to be poorly absorbed in the gastrointestinal tract. However, absorption is highly dependent on the water and lipid solubility of the specific chemical form(s) in which it is present. An absorption factor of 5 percent was used for metals. This value corresponds to the default value suggested by EPA for cases in which the gastrointestinal absorption of a substance is not known (EPA, 1989).

9.3.4 Summary

The slope factors for the carcinogenic pollutants are presented in Table 9-1. The reference or basis for each of the slope factors is indicated.

9.4 REFERENCE DOSES FOR NONCARCINOGENIC EFFECTS

RfDs are developed for specific exposure routes (oral, dermal, inhalation) and also are derived for chronic exposures and subchronic exposures (defined by EPA as 7 years or longer and 2 weeks to 7 years, respectively)(EPA, 1989). In this toxicity assessment, only chronic reference doses were employed because exposure to the individual is assumed to occur over a lifetime. Chronic dermal RfDs had to be derived using established procedures because EPA has not yet assigned RfDs for chemicals with the potential for dermal

exposures. The RfDs used in this toxicity assessment are discussed, by exposure route, in the subsections that follow.

9.4.1 Oral Route

Establishing oral RfDs was a step-by-step process based on setting up a hierarchy for the available information as follows:

1. The Integrated Risk Information System (IRIS, 1990) computer data base was searched for each chemical. All reported RfDs found were used since these are the most current EPA-approved RfDs.

2. If RfDs were not available on IRIS, the Health Effects Assessment Summary Tables (HEAST) (EPA, 1990) were consulted for each chemical. If a RfD was located, it was used since these numbers have been established by EPA's Environmental Criteria and Assessment Office specifically for use in risk assessments under CERCLA and RCRA.

3. When RfDs were not available through EPA sources, several recent risk assessment documents written for the on-post and off-post operable units of the Rocky Mountain Arsenal (Ebasco, 1990; ESE et al., 1989) were consulted. RfDs had previously been derived for some chemicals not available in the EPA databases/documents. As these RfDs were already approved by the EPA, they were used where appropriate.

4. If an RfD was available for a structurally-related compound, it was used.

5. All other RfDs were derived by WESTON's toxicologists. See Appendix 9-A for the RfD derivations.

6. There were no toxicity data available on which to base an oral RfD for dibenzofuran.

9.4.2 Inhalation Route

As for the oral route, establishing inhalation RfDs was a step-by-step process based on developing a hierarchy for the available information as follows:

1. The Integrated Risk Information System (IRIS, 1990) computer data base was searched for each chemical. All RfDs found were used since these are the most current EPA approved RfDs.

2. If RfDs were not available on IRIS, the Health Effects Assessment Summary Tables (HEAST) (EPA, 1990) were consulted for each chemical. If a RfD was found, it was used since these numbers have been established by EPA's Environmental Criteria and Assessment Office specifically for risk assessments under CERCLA and RCRA sites. On occasion, a HEAST value was presented in mg/m^3. The following equation was used to convert the value to mg/kg/day (EPA, 1989):

$$\text{RfD} = \frac{\text{RfD } (mg/m^3) \times 20\ (m^3/day)}{70\ kg}$$

3. When the RfDs were not available through EPA sources, several recent risk assessment documents written for the on-post and off-post operable units of the RMA (Ebasco, 1990; ESE et al., 1989) were consulted. RfDs had previously been derived RfDs for some chemicals not available in the EPA databases/documents. As these RfDs were already approved by the EPA, they were used as reference doses where appropriate.

4. If an annual National Ambient Air Quality Standard (NAAQS) was available for a pollutant, it was converted into a RfD.

5. Occupational Exposure Limits (OELs) were used next to calculate inhalation RfDs. The OELs that were considered included the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs)(ACGIH, 1990), the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL)(DOL, 1989) and the National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) (CDC, 1988).

6. If both a short term NAAQS and an OEL were available for a chemical, the most conservative derived inhalation RfD was used.

7. For the remaining organic pollutants, the chronic oral RfD was used, by default, as the chronic inhalation RfD. For the derivation of the inorganic pollutant lithium, refer to Appendix 9B.

8. There were several chemicals for which there were insufficient data to derive an inhalation RfD. These included dibenzofuran, phosphate, potassium, sodium and strontium.

9.4.2.1 <u>The Use of OELs and NAAQSs</u>

It is recognized that there are several factors that limit the usefulness of occupational guidelines in the derivation of RfDs. OELs are intended to protect healthy workers from adverse health effects when exposed to a chemical in the workplace over a 40-hour work week. Inhalation RfDs are intended to protect the general population, including sensitive sub-populations, based on a continuous exposure. Furthermore, OELs are derived by consensus as opposed to a procedure that incorporates standard uncertainty factors according to the nature of the toxicological database from which the RfD is derived. OELs

also may be based on toxic endpoints other than chronic noncarcinogenic health effects (e.g., irritation and odor).

In consideration of the limitations of the OELs, an equation was developed to derive inhalation RfDs from OELs, incorporating uncertainty factors to account for potential continuity of exposure and variability in human sensitivity. In addition, the data and/or toxic endpoint for each of the applicable OELs were reviewed to ensure that the OEL was suitable to serve as the basis for a chronic inhalation RfD (ACGIH, 1986; CDC, 1988; DOL, 1989). For each chemical, the most conservative OEL that has been developed, and which is based on, or protective against, noncarcinogenic effects, was used to derive the inhalation RfD. The equation and assumptions that were used to calculate inhalation RfDs from OELs are presented in Table 9-3. The approach is consistent with EPA guidelines for deriving an RfD from a NOAEL (EPA, 1989). The equation calculates a daily dose to an exposed worker, normalized over a 7-day exposure period (i.e., the NOAEL), and adjusts the dose by an uncertainty factor of 10 to take into account human variability and a modifying factor of 10 to account for continuous daily exposure.

NAAQSs include primary standards, which are ambient air quality standards, that are judged to be protective of public health with an adequate margin of safety, and secondary standards, which are intended to protect the public welfare from any adverse effects (EPA, 1987).

If an annual average NAAQS was available for a pollutant, it was used in preference to an OEL as a basis for the inhalation RfD, because an annual average NAAQS is developed to protect the general population, not just workers, over a long-term exposure period. Subsequently, the inhalation RfD for particulate matter, sulfur dioxide, and nitrogen oxides were calculated from the respective NAAQS expressed as an annual arithmetic mean, assuming an inhalation rate of 20 m^3/day and a body weight of 70 kg. If only a short-term (i.e., less than annual) NAAQS was available, RfDs were derived using both the short-term value and the OEL, and the most conservative value was used. A short-term NAAQS and OEL were both available for carbon monoxide. The lowest derived RfD, 4.08E-02

mg/kg/day, was calculated based on an OEL, an REL of 40 mg/m^3 (CDC, 1988). The NAAQS for carbon monoxide represents an 8-hour average. Assuming the inhalation of 20 m^3 of air/day and a body weight of 70 kg, and applying a modifying factor of 10 to extrapolate from a short-term criterion to a long-term criterion, an RfD of 2.86E-01 mg/kg/day was obtained based on the NAAQS. The lowest calculated value, which was that based on the OEL, was used.

9.4.2.2 Adjustments to Inhalation RfDs

In the absence of an OEL (or an NAAQS) for dioxins/furans, the oral RfD for dioxins/furans (see Subsection 9.4.2) was used as the basis for the inhalation RfD. As previously discussed in Subsection 9.3.1, EPA (1989) has similarly based the inhalation potency factor for 2,3,7,8-TCDD on the oral potency factor indicating that its toxicity is presumed to be the same through both the oral and inhalation routes. Comparable to the approach used in deriving the inhalation potency factor, the inhalation RfD was adjusted for the fraction of inhaled particles by dividing the oral RfD by 75 percent.

9.4.3 Dermal Route

No RfDs have been developed by EPA for the dermal route. Therefore, dermal RfDs were derived for the chemicals of concern in accordance with EPA guidelines (EPA, 1989). Chronic dermal RfDs were derived by multiplying the values used as the chronic oral RfDs by appropriate gastrointestinal absorption factors. The absorption factors that were used in deriving the dermal RfDs were the same as those used in deriving the dermal slope factors (see Subsection 9.3.3). Gastrointestinal absorption factors of 90 percent (0.90), 50 percent (0.50), and 5 percent (0.05) were assumed for volatile organics, semi-volatile organics, and inorganics, respectively.

The RfDs that were used in the evaluation of noncarcinogenic risk are presented in Table 9-4. The source or basis of each of the RfDs is also indicated. No toxicity information was available for dibenzofuran; therefore, RfDs could not be derived for any route of exposure.

9.4.4 Summary

This section presents the sources of information and methods used to determine chronic toxicity criteria for carcinogens and noncarcinogens. Tables 9-3 and 9-4 summarize the carcinogenic slope factors and reference doses for noncarcinogenic effects, respectively. As there were a number of chemicals for which EPA has not derived reference doses by certain routes of exposure, detailed discussions of the toxicity studies and uncertainty factors applied to derive the RfDs were presented in this section and in Appendices 9A and 9B.

Table 9-1

Rocky Mountain Arsenal (RMA)
Slope Factors for Carcinogenic Health Effects $(mg/kg/day)^{-1}$

Pollutant	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification	Inhalation Route Slope Factor	Reference or Basis of Inhalation Slope Factor	Oral Route Slope Factor	Reference or Basis of Oral Slope Factor	Dermal Route Slope Factor
Organics							
Acrylonitrile	B1	2A	2.40E-01	IRIS, 1990	5.40E-01	IRIS, 1990	NC (v)
Aldrin	B2	3	1.70E+01	IRIS, 1990	1.70E+01	IRIS, 1990	3.40E+01 (sv)
Benzene	A	1	2.90E-02	IRIS, 1990	2.90E-02	IRIS, 1990	NC (v)
Carbazole	B2	3	2.00E-02	OSF	2.00E-02	EBASCO, 1990	4.00E-02 (sv)
Carbon Tetrachloride	B2	2B	1.30E-01	IRIS, 1990	1.30E-01	IRIS, 1990	NC (v)
Chloroform	B2	2B	8.10E-02	IRIS, 1990	6.10E-03	IRIS, 1990	NC (v)
DDE	B2	NL	3.40E-01	OSF	3.40E-01	IRIS, 1990	6.80E-01 (sv)
DDT	B2	2B	3.40E-01	IRIS, 1990	3.40E-01	IRIS, 1990	6.80E-01 (sv)
1,4-Dichlorobenzene	B2	2B	2.40E-02	OSF	2.40E-02	EPA, 1990	NC (v)
1,1-Dichloroethene	C	3	1.20E+00	IRIS, 1990	6.00E-01	IRIS, 1990	NC (v)
1,2-Dichloropropane	B2	3	6.80E-02	OSF	6.80E-02	EPA, 1990	NC (v)
Dieldrin	B2	3	1.60E+01	IRIS, 1990	1.60E+01	IRIS, 1990	3.20E+01 (sv)
Dioxins/Furans (as 2,3,7,8 TCDD)	B2	2B	1.13E+05[a]	EPA, 1990	1.50E+05	EPA, 1990	3.00E+05 (sv)
Hexachlorobenzene	B2	2B	1.60E+00	EPA, 1990	1.60E+00	EPA, 1990	3.20E+00 (sv)

Table 9-1
(continued)

Pollutant	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification	Inhalation Route Slope Factor	Reference or Basis of Inhalation Slope Factor	Oral Route Slope Factor	Reference or Basis of Oral Slope Factor	Dermal Route Slope Factor
Methyl Chloride	C	3	6.30E-03	EPA, 1990	1.30E-02	EPA, 1990	NC (v)
Methylene Chloride	B2	2B	1.40E-02	EPA, 1990	7.50E-03	EPA, 1990	NC (v)
PAHs	---	---	---	---	---	---	---
Benzo[a]pyrene	B2	2A	6.10E+00	EPA, 1986	1.15E+01	EPA, 1986	2.30E+01 (sv)
Chrysene	B2	3	6.10E+00[b]	EPA, 1986	1.15E+01[b]	EPA, 1986	2.30E+01 (sv)
Dibenzo[a,h]anthracene[c]		2A	6.10E+00[b]	EPA, 1986	1.15E+01[b]	EPA, 1986	2.30E+01 (sv)
Parathion	C	3	NSF	---	NSF	NSF	---
Quinoline	C	NCL	1.20E+01	OSF	1.20E+01	EPA, 1990	2.40E+01 (sv)
Styrene	B2	2B	2.00E-03	EPA, 1990	3.00E-02	EPA, 1990	NC (v)
Tetrachloroethene	B2	2B	3.30E-03	EPA, 1990	5.10E-02	EPA, 1990	NC (v)
Trichloroethene	B2	3	1.10E-02	EPA, 1990	1.10E-02	EPA, 1990	NC (v)
Vapona	B2	3	2.90E-01	OSF	2.90E-01	IRIS, 1990	5.80E-01 (sv)
Vinyl Chloride	A	1	2.95E-01[d]	EPA, 1990	2.30E+00	EPA, 1990	NC (v)
Inorganics							
Arsenic	A	1	1.50E+01[e]	IRIS, 1990	1.75E+00	EPA, 1990	3.50E+01 (i)
Beryllium	B2	2A	8.40E+00	IRIS, 1990	4.30E+00	IRIS, 1990	8.60E+01 (i)
Cadmium	B[f]	2A	6.10E+00	IRIS, 1990	NC	---	NC (i)
Chromium (VI)	A[f]	1	4.10E+01	IRIS, 1990	NC	---	NC (i)

Table 9-1
(continued)

Pollutant	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification	Inhalation Route Slope Factor	Reference or Basis of Inhalation Slope Factor	Oral Route Slope Factor	Reference or Basis of Oral Slope Factor	Dermal Route Slope Factor
Lead	B2	2B	NSF	---	NSF	---	NSF
Nickel (as soluble salts)	A[f]	1	2.00E-02	IRIS, 1990	NC	---	NC (i)

Footnotes:

NL = Not listed
NSF = No slope factor was available
OSF = Oral Slope Factor
- Substance was treated as a volatile (v), semi-volatile (sv), or an inorganic (i) in deriving the dermal slope factor.
[a] Based on a slope factor of 1.56E+05 $(mg/kg/day)^{-1}$, adjusted for 0.75 inhalation retention.
[b] The slope factor for benzo(a)pyrene was used.
[c] The compound originally predicted in the waste stream was incorrectly identified as dibenzo(a)anthracene. This compound is assumed to be dibenzo(a,h)anthracene.
[d] Based on metabolized dose.
[e] Calculated from a proposed unit risk, as $(ug/L)^{-1}$, assuming the ingestion of 2 liters of water/day and a body weight of 70 kg.
[f] Classification is for the inhalation route only.

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Table 9-2

EPA and IARC Categorizations of Carcinogens Based on Human and Animal Evidence

EPA Categorization of Carcinogens (EPA, 1986b)

	Animal Evidence				
	Sufficient	Limited	Inadequate	No Data	No Evidence
<u>Human Evidence</u>					
Sufficient	A	A	A	A	A
Limited	B1	B1	B1	B1	B1
Inadequate	B2	C	D	D	D
No data	B2	C	D	D	E
No evidence	B2	C	D	D	E

<u>Key:</u>

Group A - Human carcinogen (sufficient evidence from epidemiological studies).

Group B1 - Probable human carcinogen (at least limited evidence of carcinogenicity to humans).

Group B2 - Probable human carcinogen (a combination of sufficient evidence in animals and inadequate data in humans).

Group C - Possible human carcinogen (limited evidence in animals in the absence of human data).

Group D - Not classified (inadequate animal and human data).

Group E - No evidence for carcinogenicity (no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies).

Table 9-2
(continued)

IARC Categorization of Carcinogens (WHO, 1987)
Group 1 - Human carcinogen (sufficient evidence of carcinogenicity in humans).
Group 2A - Probable human carcinogen (limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals).
Group 2B - Possible human carcinogen (limited evidence of carcinogenicity in humans and insufficient evidence of carcinogenicity in experimental animals; insufficient evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals; or insufficient evidence of carcinogenicity in humans and limited evidence of carcinogenicity in experimental animals, with supporting evidence from other relevant data).
Group 3 - Not classifiable (substances in this category do not fall into any other category).
Group 4 - Probably not carcinogenic to humans.

Table 9-3

Approach to Deriving an Inhalation Reference Dose (RfD) from an Occupational Exposure Limit (OEL)

$$\text{Inhalation RfD (mg/kg/day)} = \frac{\text{OEL (mg/m}^3\text{)} \times \text{Air breathed per work day (m}^3\text{/day)} \times \text{Work week adjustment factor}}{\text{Body weight (kg)} \times \text{Uncertainty factor}}$$

Where:

Inhalation RfD	=	Inhalation reference dose.
OEL	=	Occupational exposure limit.
Air breathed per work day	=	10 cu m. This value has been used by EPA when deriving an inhalation-acceptable chronic intake (AIC) for the public from worker exposure levels (EPA, 1984b).
Work week adjustment factor	=	5 days/7 days. Because the OEL is based on a 5-day work week, an adjustment was made to average the dose over a 7-day week.
Body weight	=	70 kg (weight of an average adult) (EPA, 1989b).
Uncertainty factor	=	100. A factor of 10 is recommended by the U.S. EPA when deriving RfDs from human data to account for human variation (i.e., to protect sensitive members of the general population (e.g., children and the elderly) (EPA, 1989b). An additional modifying factor of 10 was included to take into account a continuous exposure for a resident (versus an intermittent exposure for a worker) and a lifetime exposure for a resident (versus a less than lifetime exposure for a worker). Uncertainty factors of 10 to 100 are commonly used by government agencies when deriving public health criteria from OELs (EPA, 1984b; MDNR, 1989; PAMS, 1983).

Table 9-4

Rocky Mountain Arsenal (RMA)
Reference Doses (RfDs) for Noncarcinogenic Health Effects (mg/kg/day)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Organics					
Acetone	1.82E+00	ACGIH-TWA	1.00E-01	EPA, 1990	NC (v)
Acetonitrile	1.00E-02	EPA, 1990	6.00E-02	EPA, 1990	3.00E-02 (sv)
Acrylonitrile	4.39E-03	ACGIH-TWA	2.70E-04	Derived	NC (v)
Aldrin	2.55E-04	ACGIH-TWA	3.00E-05	IRIS, 1990	1.50E-05 (sv)
Atrazine	5.10E-03	ACGIH-TWA	5.00E-03	IRIS, 1990	2.50E-03 (sv)
Benzaldehyde	1.00E-01	Oral RfD	1.00E-01	IRIS, 1990	5.00E-02 (sv)
Benzene	3.26E-02	ACGIH-TWA	1.00E-03	Derived	NC (v)
Benzofuran	5.00E-03	Oral RfD	5.00E-03	Derived	2.50E-03 (sv)
Benzoic Acid	4.00E+00	Oral RfD	4.00E+00	IRIS, 1990	2.00E+00 (sv)
Benzonitrile	8.00E-03	Oral RfD	8.00E-03	Derived	4.00E-03 (sv)
Biphenyl	1.33E-03	ACGIH-TWA	5.00E-02	EPA, 1990	NC (v)
Bromomethane	1.71E-02	EPA, 1990	1.40E-03	IRIS, 1990	NC (v)
Carbazole	5.00E-03	Oral RfD	5.00E-03	Derived	2.50E-03 (sv)
Carbon Tetrachloride	3.16E-02	ACGIH-TWA	7.00E-04	IRIS, 1990	NC (v)
Chlorobenzene	5.00E-03	EPA, 1990	2.00E-02	IRIS, 1990	NC (v)
4-Chlorobiphenyl	2.45E-02	Oral RfD	2.45E-02	Derived	1.22E-02 (sv)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
4,4'-Chlorobiphenyl	2.33E-02	Oral RfD	2.33E-02	Derived	1.16E-02 (sv)
Chloroform	5.00E-02	ACGIH-TWA	1.00E-02	IRIS, 1990	NC (v)
4-Chlorophenylmethylsulfone	1.98E-02	Oral RfD	1.98E-02	EBASCO, 1990	9.90E-03 (sv)
4-Chlorophenylmethylsulfoxide	1.98E-02	Oral RfD	1.98E-02	EBASCO, 1990	9.90E-03 (sv)
DDE	5.00E-04	Oral RfD	5.00E-04	IRIS, 1990	2.50E-04 (sv)
DDT	1.02E-03	ACGIH-TWA	5.00E-04	IRIS, 1990	2.50E-04 (sv)
Dibenzofuran	NRD	---	NRD	---	NRD
Dichlorobenzene	4.00E-02	EPA, 1990	9.00E-02	EPA, 1990	NC (v)
1,1-Dichloroethene	2.04E-02	ACGIH-TWA	9.00E-02	EPA, 1990	NC (v)
1,2-Dichloroethene(total)	8.10E-01	ACGIH-TWA	9.00E-03	IRIS, 1990	NC (v)
1,2-Dichloropropane	3.54E-01	ACGIH-TWA	2.00E-02	IRIS, 1990	NC (v)
Dieldrin	2.55E-04	ACGIH-TWA	5.00E-05	IRIS, 1990	2.50E-05 (sv)
Diisopropyl Methylphosphonate	8.00E-02	Oral RfD	8.00E-02	IRIS, 1990	4.00E-02 (sv)
1,3-Dimethylbenzene	2.00E-01	EPA, 1990	5.00E-02	Derived	2.50E-02 (sv)
Dimethyldisulfide	8.10E-03	Oral RfD	8.10E-03	EBASCO, 1990	NC (v)
Dimethyl Methylphosphonate	1.80E-02	Oral RfD	1.80E-02	EBASCO, 1990	9.00E-03 (sv)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Dimethylphosphate	8.71E-02	Oral RfD	8.71E-02	Derived	4.36E-02 (sv)
Dioxins/Furans (as 2,3,7,8 TCDD)	1.00E-09	Oral RfD	1.00E-09	ATSDR, 1989	5.00E-10 (sv)
Dithiane	1.00E-02	Oral RfD	1.00E-02	EBASCO, 1990	5.00E-03 (sv)
Endrin	1.02E-04	ACGIH-TWA	3.00E-04	IRIS, 1990	1.50E-04 (sv)
Ethylbenzene	4.43E-01	ACGIH-TWA	1.00E-01	IRIS, 1990	NC (v)
Hexachlorobenzene	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04 (sv)
Hexachlorocyclopentadiene (HCCPD)	2.00E-05	EPA, 1990	7.00E-03	IRIS, 1990	3.50E-03 (sv)
Isodrin	7.00E-05	Oral RfD	7.00E-05	EBASCO, 1990	3.50E-05 (sv)
Malathion	1.02E-02	ACGIH-TWA	2.00E-02	IRIS, 1990	1.00E-02 (sv)
Methanol	2.67E-01	ACGIH-TWA	5.00E-01	IRIS, 1990	2.50E-01 (sv)
Methyl Chloride	1.05E-01	ACGIH-TWA	1.80E-02	Derived	NC (v)
Methylene Chloride	8.57E-01	EPA, 1990	6.00E-02	EPA, 1990	NC (v)
4-Nitrophenol	2.50E-03	Oral RfD	2.50E-03	Derived	1.25E-03 (sv)
PAHs					
Acenaphthalene	6.00E-02	Oral RfD	6.00E-02	IRIS, 1990	3.00E-02 (sv)
Acenaphthene	6.00E-02	Oral RfD	6.00E-02	EPA, 1990	3.00E-02 (sv)
Benzo[a]pyrene	3.00E-02[b]	Oral RfD	3.00E-02[b]	IRIS, 1990	1.50E-02 (sv)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Chrysene	3.00E-02[b]	Oral RfD	3.00E-02[b]	IRIS, 1990	1.50E-02 (sv)
Dibenzo[a,h]anthracene	3.00E-02[b]	Oral RfD	3.00E-02[b]	IRIS, 1990	1.50E-02 (sv)
Fluoranthene	4.00E-02	Oral RfD	4.00E-02	EPA, 1990	2.00E-02 (sv)
Fluorene	4.00E-02	Oral RfD	4.00E-02	IRIS, 1990	2.00E-02 (sv)
Phenanthrene	3.00E-02[b]	Oral RfD	3.00E-02[b]	EPA, 1990	1.50E-02 (sv)
Pyrene	3.00E-02	Oral RfD	3.00E-02	IRIS, 1990	1.50E-02 (sv)
Parathion	5.10E-05	REL	6.00E-03	EPA, 1990	3.00E-03 (sv)
Pentachlorobenzene	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04 (sv)
Phenol	1.94E-02	ACGIH-TWA	6.00E-01	IRIS, 1990	3.00E-01 (sv)
Pyridine	1.63E-02	ACGIH-TWA	1.00E-03	IRIS, 1990	NC (v)
Quinoline	2.00E-01	Oral RfD	2.00E-01	IRIS, 1990	1.00E-01 (sv)
Styrene	2.17E-01	ACGIH-TWA	2.00E-01	IRIS, 1990	NC (v)
Supona	1.50E-04	Oral RfD	1.50E-04	EBASCO, 1990	7.50E-05 (sv)
Tetrachlorobenzene	3.00E-04	Oral RfD	3.00E-04	IRIS, 1990	1.50E-04 (sv)
Tetrachloroethene	3.46E-01	ACGIH-TWA	1.00E-02	IRIS, 1990	NC (v)
Toluene	5.71E-01	EPA, 1990	2.00E-01	IRIS, 1990	NC (v)
Trichlorobenzene	3.00E-03	EPA, 1990	2.00E-02	EPA, 1990	1.00E-02 (sv)
Trichloroethene	2.74E-01	ACGIH-TWA	7.35E-03	EPA, 1987	NC (v)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Urea	8.47E-02	Oral RfD	8.47E-02	Derived	4.28E-02 (sv)
Vapona	8.00E-04	Oral RfD	8.00E-04	IRIS, 1990	4.00E-04 (sv)
Vinyl Chloride	1.33E-02	ACGIH-TWA	1.30E-03	Derived	NC (v)
Xylenes (total)	8.57E-02	EPA, 1990	2.00E+00	EPA, 1990	NC (v)
Inorganics					
Aluminum	2.04E-03[c]	ACGIH-TWA	NE	---	NC (i)
Ammonia	1.73E-02	ACGIH-TWA	NE	---	NC (i)
Antimony	5.10E-04	ACGIH-TWA	4.00E-04	IRIS, 1990	2.00E-05 (i)
Arsenic	2.04E-04	ACGIH-TWA	1.00E-03	EPA, 1990	5.00E-05 (i)
Barium	1.00E-04	EPA, 1990	7.00E-02	IRIS, 1990	3.50E-03 (i)
Beryllium	2.04E-06	ACGIH-TWA	5.00E-03	IRIS, 1990	2.50E-04 (i)
Boron	4.11E-03[d]	ACGIH-TWA	NE	---	NC (i)
Cadmium	5.10E-05	ACGIH-TWA	1.00E-03	IRIS, 1990	NC (i)
Calcium	1.46E-03[c]	ACGIH-TWA	NC	---	NC (i)
Chromium (III)	5.10E-04	ACGIH-TWA	NE	---	NC (i)
Chromium (VI)	5.10E-05	ACGIH-TWA	5.00E-03	IRIS, 1990	NC (i)
Cobalt	5.10E-05	ACGIH-TWA	2.30E-03	Derived	NC (i)
Copper	1.00E-02	EBASCO, 1990	3.80E-02	EBASCO, 1990	1.90E-03 (i)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Cyanogen	2.14E-02	ACGIH-TWA	NE	---	NC (i)
Hydrogen Cyanide	5.10E-03	ACGIH-TWA	NE	---	NC (i)
Iron	1.02E-03[f]	ACGIH-TWA	NE	---	NC (i)
Lead	4.30E-04	EBASCO, 1990	1.40E-03	EBASCO, 1990	7.00E-05 (i)
Lithium	1.00E-04	Derived	NE	---	NC (i)
Magnesium	6.15E-03[g]	ACGIH-TWA	NE	---	NC (i)
Manganese	3.00E-04	EPA, 1990	NE	---	NC (i)
Mercury	8.57E-05	EPA, 1990	3.00E-04	EPA, 1990	1.50E-05 (i)
Molybdenum	5.10E-03[h]	ACGIH-TWA	NE	---	NC (i)
Nickel	1.02E-04[i]	ACGIH-TWA	NE	---	NC (i)
Phosphate	NRD	---	NC	---	NC (i)
Potassium	NRD	---	NC	---	NC (i)
Selenium	2.04E-04	ACGIH-TWA	3.00E-03	EPA, 1990	1.50E-04 (i)
Silicon	5.10E-05[j]	ACGIH-TWA	NC	---	NC (i)
Silver	1.02E-05[k]	ACGIH-TWA	3.00E-03	IRIS, 1990	1.50E-04 (i)
Sodium	NRD	---	NC	---	NC (i)
Strontium	NRD	---	NE	---	NC (i)
Thallium	1.02E-04	ACGIH-TWA	7.00E-05	EPA, 1990	3.50E-06 (i)

Table 9-4
(continued)

Pollutant	Inhalation Route RfD	Reference or Basis of Inhalation RfD	Oral Route RfD	Reference or Basis of Oral RfD	Dermal Route RfD
Tin	2.04E-03	ACGIH-TWA	NE	---	NC (i)
Titanium	6.11E-03[l]	ACGIH-TWA	NE	---	NC (i)
Vanadium	5.10E-05	ACGIH-TWA	7.00E-03	EPA, 1990	NC (i)
Yttrium	1.02E-03	ACGIH-TWA	NE	---	NC (i)
Zinc	8.19E-03[m]	ACGIH-TWA	2.00E-01	EPA, 1990	NC (i)
Other Acid Gases/ Criteria Pollutants					
Carbon Monoxide	4.08E-02	REL	ID	---	ID
Hydrogen Chloride	7.65E-03	ACGIH-TWA	ID	---	ID
Hydrogen Fluoride	2.65E-03	ACGIH-TWA	ID	---	ID
Nitric Acid	5.30E-03	ACGIH-TWA	ID	---	ID
Nitrogen Oxides	2.86E-02	NAAQS	ID	---	ID
Particulate Matter	4.29E-02	NAAQS	NC	---	NC
Sulfur Dioxide	2.29E-02	NAAQS	ID	---	ID
Sulfuric Acid Mist	1.02E-03	ACGIH-TWA	ID	---	ID

Table 9-4
(continued)

Footnotes:

ACGIH-TWA	=	American Conference of Governmental Industrial Hygienists. Time-Weighted Average
ID	=	There were insufficient data to predict the fate in either surface water or soil. The chemical was therefore not evaluated through the inhalation or dermal route.
NAAQS	=	National Ambient Air Quality Standard
NC	=	Not of concern through this exposure route (see Subsection 8)
NE	=	Not evaluated. Substance is of concern through the fish ingestion pathway only, but could not be evaluated due to the availability of a fish bioconcentration factor
NRD	=	No reference dose available
REL	=	Recommended exposure limit

- Substance was treated as a volatile (v), semi-volatile (sv), or inorganic (i) in deriving the dermal reference dose.

[a] Value is for 1,2-dichlorobenzene, the most conservative RfD that was available for a dichlorobenzene isomer.
[b] Value is for pyrene, the most conservative RfD that was available for a structurally similar PAH.
[c] Converted from TLV for soluble salts as aluminum.
[d] Converted from TLV for boron oxide and converted to "as boron."
[e] Converted from TLV for calcium oxide and converted to "as calcium."
[f] Converted from TLV for soluble salts as iron, the most conservative value for inorganic iron.
[g] Converted from TLV for magnesium oxide fume and converted to "as magnesium."
[h] Converted from TLV for soluble compounds as molybdenum, the most conservative value.
[i] Converted from TLV for soluble compounds as nickel, the most conservative value.
[j] Converted from TLV for respirable crystalline or fused silica, the most conservative values.
[k] Converted from TLV for soluble compounds as silver, the most conservative value.
[l] Converted from TLV for titanium dioxide and converted to "as titanium."
[m] Converted from TLV for zinc oxide dust rather than fume and converted to "as zinc."

SECTION 9

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SECTION 10

RISK CHARACTERIZATION

In this section, both carcinogenic and noncarcinogenic risks as a result of exposure under base case emissions conditions were evaluated based on the pollutant daily intakes calculated in Section 8 and the toxicity values presented in Section 9. The total lifetime carcinogenic risk was calculated based on a combination of adult, child, and infant exposure for the Resident-A, Resident-B, and Farmer scenarios. The noncarcinogenic risk was evaluated separately for adult, child, and infant exposure. The Worker scenario evaluated carcinogenic and noncarcinogenic risk only for an adult. The results presented in this section were determined on the basis of base case (i.e., conservatively estimated average) emission rates. Risk estimates for sensitivity case emissions (worst-case maximum) are summarized and discussed in Section 11 in the "Sensitivity Analysis."

10.1 DETERMINATION OF CARCINOGENIC RISK

Carcinogenic risk was calculated for each carcinogen through each exposure pathway for each individual. An individual's total excess lifetime carcinogenic risk in any given exposure scenario was defined as the sum of adult, child, and infant risks, which were appropriately adjusted for exposure duration. Total lifetime carcinogenic risk was based on the summation of the individual risks for the adult, child, and infant for the applicable scenarios. Calculation of a total carcinogenic risk allows an evaluation of overall potential risk and a pinpointing of those routes and pollutants that result in the highest relative risks. Carcinogenic risk will be calculated for each route of exposure using the following formula:

$$\text{Risk} = \text{EDI} \times \text{CSF} \times \text{EDA}$$

Where:

Risk = Excess lifetime carcinogenic risk
EDI = Estimated daily intake (mg/kg/day)

CSF = Carcinogenic slope factor $(mg/kg/day)^{-1}$
EDA = Exposure duration adjustment

The carcinogenic slope factors for the inhalation, oral, and dermal routes of exposure are presented in Table 9-3. The estimated daily intakes were previously determined for the appropriate routes of exposure in Section 8. The estimated daily intakes and exposure duration adjustments used for the adult, child, and infant are discussed in the subsections that follow. The exposure duration adjustment compensates for exposure periods of less than 70 years. Carcinogenic risks were based upon average estimated daily intakes, which were derived from soil concentrations averaged over a 70-year lifetime.

10.1.1 Adult Carcinogenic Risk

As presented in the previous equation, the carcinogenic risk resulting from exposure to a particular chemical is dependent on three factors: dosage, the carcinogenic potency of the chemical, and exposure duration. Adults doses are summarized at the end of Section 8. Average doses were used in determining carcinogenic risk for the adult, since carcinogenic risk is based on exposure over 70 years (average lifetime exposure), the majority of which occurs as an adult. The length of exposure also is taken into account in the calculation of risk, since carcinogenic potency factors are based on an exposure duration of 70 years, and carcinogenic risk is assumed to be proportional to exposure duration.

For the Resident-A, Resident-B, and Farmer exposure scenarios, carcinogenic risk was calculated for the ingestion and dermal routes of exposure based on 1 year of exposure as an infant, 5 years of exposure as a child, and 64 years of exposure as an adult; therefore, an exposure duration adjustment of 64/70 years was used to calculate adult carcinogenic risk for these exposure routes. For the inhalation route of exposure, only 2 years of exposure (i.e., the facility lifetime) could occur over an individual's lifetime. Since children and infants are considered more sensitive to contaminant exposure, the maximum exposed individual was conservatively assumed to be in these age groups. It therefore was assumed that over a lifetime, 1 year of pollutant inhalation occurred as an infant, 1 year as a child,

and no inhalation exposure occurred as an adult. Adult carcinogenic risk from inhalation was evaluated separately and is presented in the sensitivity analysis (see Subsection 11.3).

For the Worker scenario, exposure was assumed to occur over 30 years (Ebasco, 1990), resulting in an exposure duration adjustment of 30/70 years for the ingestion and dermal routes of exposure. For worker inhalation exposure, an exposure duration adjustment of 2/70 years was used, based on the facility lifetime.

The calculated carcinogenic risk for adults through all routes of exposure are presented in Appendix 8H, Tables 8H-1 through 8H-4.

10.1.2 Child Carcinogenic Risk

The predicted childhood doses for the applicable carcinogens are summarized at the end of Section 8. As with the adult, average doses were used in determining carcinogenic risk. The childhood exposure duration was assumed to be 5 years, based on the exposure scenario described in Subsection 8.3. An exposure duration adjustment of 5/70 was used for childhood risk calculations for the ingestion and dermal exposure routes. As discussed in Subsection 10.1.1, a child was assumed to be exposed to pollutants through the inhalation route for 1 year based on overall lifetime exposure; therefore, an exposure duration of 1/70 was used for the inhalation route. Childhood carcinogenic risk estimates for each route of exposure are summarized in Appendix 8H, Tables 8H-5 through 8H-7.

10.1.3 Infant Carcinogenic Risk

Infants are considered to be a potentially sensitive subpopulation because of potential pollutant exposure through the ingestion of mother's milk. The infant also is exposed through the inhalation pathway. The predicted infant doses for the applicable carcinogens are summarized at the end of Section 8. An infant was assumed to be exposed for 1 year based on the exposure scenario described in Subsection 8.3.4; therefore, an exposure duration adjustment of 1/70 was used in calculating carcinogenic risk. Since infants are

exposed only for any 1 year during which exposure concentrations will be at a maximum, and in order to prevent underestimation of carcinogenic risk, maximum daily intakes determined for the mother were used instead of average lifetime daily intakes in calculating breast milk concentrations and infant carcinogenic risk. Tables 8H-8 and 8H-10 (Appendix 8H) present the estimates of carcinogenic risk based on inhalation and mother's milk ingestion for all of the applicable exposure scenarios.

10.1.4 Total Carcinogenic Risk

The total carcinogenic risk for each exposure scenario was calculated by summing the individual risks calculated for the adult, child, and infant. As previously stated, the Worker scenario was evaluated only for an adult. The results are shown in Tables 10-1 through 10-4 for the Resident-A, Resident-B, Farmer, and Worker scenarios, respectively. (All tables are presented at the end of this section.) The following equation was used to calculate total risk:

$$Risk_{total} = Risk_{inhl} + Risk_{ing} + Risk_{der}$$

Where:

$Risk_{total}$ = Total carcinogenic risk

$Risk_{inhl}$ = Childhood and infant carcinogenic risk (Resident-A, Resident-B, and Farmer scenarios), or adult carcinogenic risk (Worker scenario) associated with the inhalation route of exposure

$Risk_{ing}$ = Adult, childhood, and infant carcinogenic risk (Resident-A, Resident-B, and Farmer scenarios) or adult carcinogenic risk (Worker scenario) associated with the ingestion route of exposure

$Risk_{der}$ = Adult and childhood carcinogenic risk (Resident-A, Resident-B, and Farmer Scenarios) or adult carcinogenic risk (Worker scenario) associated with the dermal route of exposure

10.2 DETERMINATION OF NONCARCINOGENIC RISK

In this subsection, noncarcinogenic risks were evaluated by comparing predicted maximum daily intakes to reference doses (RfDs). This was accomplished by the calculation of hazard quotients and hazard indices. A hazard quotient for a particular pollutant through a given exposure route is the ratio between the predicted daily intake and the applicable RfD, as shown in the following equation:

$$HQ = MDI/RfD$$

Where:

HQ	=	Hazard quotient
MDI	=	Maximum estimated daily intake (mg/kg/day)
RfD	=	Reference dose (mg/kg/day).

Maximum estimated daily intakes were based on maximum soil concentrations achieved over the 2-year facility lifetime.

A total exposure hazard index was calculated for the adult, child, and infant in each scenario (except the worker, which is adult only) by summing the hazard quotients for all pollutants through all exposure routes. It is important to note that this methodology, unlike the methodology used in the evaluation of carcinogenic risk, is not a measure of and cannot be used to quantify risk (i.e., it does not predict the relative likelihood or probability of the occurrence of adverse effects). If a hazard quotient or hazard index exceeds 1, it simply indicates that there might be a potential for noncarcinogenic health effects occurring under the defined exposure conditions. Because RfDs incorporate a margin of uncertainty, exceedance of a criterion does not necessarily indicate that an adverse effect will occur. It also should be noted that, unlike the estimation of carcinogenic risk, the evaluation of noncarcinogenic risk does not involve an adjustment for the number of years of exposure. It is assumed that any chronic exposure, regardless of the duration, might potentially result in adverse effects if the RfD is exceeded in a given period of an individual's life (e.g., infancy, childhood, or adulthood). RfDs are presented in Table 9-4 in Subsection 9.4. All

pollutants, both carcinogens and noncarcinogens, were evaluated for potential noncarcinogenic effects.

10.2.1 Adult Noncarcinogenic Risk

The maximum estimated daily intakes for the pollutants of concern used in the evaluation of noncarcinogenic risk were presented in Subsection 8.2. Adult hazard quotients were calculated for the inhalation, ingestion, and dermal routes of exposure. These and the respective hazard indices are presented in Tables 10-5 through 10-8 for the Resident-A, Resident-B, Farmer, and Worker adult scenarios, respectively.

10.2.2 Child and Infant Noncarcinogenic Risk

Noncarcinogenic risk for the child and infant was evaluated by the same method used for the adult. Predicted maximum estimated daily intakes for children and infants were presented in Subsection 8.3. Hazard quotients were calculated for the inhalation, ingestion, and dermal routes of exposure for children. These and the respective hazard indices are presented in Tables 10-9 and 10-11 for the child and in Tables 10-12, 10-13, and 10-14, for the Resident-A, Resident-B, and Farmer Scenarios, respectively.

10.3 RESULTS

10.3.1 Carcinogenic Risk

The total carcinogenic risk for base case emissions, which were based on the addition of the risks for the adult, childhood, and infant exposure pathways, were estimated to be 1.54 chances in 100 million for Resident-A, 2.50 chances in 1 billion for Resident-B, 5.92 chances in 1 billion for the Farmer, and 7.64 chances in 10 billion for the Worker. The individual risk estimates by pollutant and by route of exposure are presented in Tables 10-1 (Resident-A), 10-2 (Resident-B), 10-3 (Farmer), and 10-4 (Worker). Table 10-15 presents the risk for each of the scenarios by pathway as a percentage of total risk. The child exposure pathway through the inhalation route represented the majority (50-55 percent) of the risk from all

scenarios, followed by the inhalation pathways in the infant (33-36 percent). Ingestion pathways (other than breast milk) contributed 5 percent or less of the risk in all scenarios for any age group. Breast milk ingestion by infants contributed 8 to 9 percent of total carcinogenic risk. Total cancer risk was, therefore, several orders of magnitude less than the 1E-06 risk criterion stated in the Final Decision Document (Woodward-Clyde, 1990).

10.3.2 Noncarcinogenic Risk

The total hazard index for each exposure scenario under base case emission conditions was calculated by summing the respective hazard quotients for all chemicals and exposure pathways for each exposed individual (adult, child, infant). Hazard indices include the potential for noncarcinogenic effects of carcinogenic substances.

Adult hazard quotients for each chemical and exposure pathway are presented in Tables 10-5 (Resident-A), 10-6 (Resident-B), 10-7 (Farmer), and 10-8 (Worker). Child hazard quotients are presented in Tables 10-9 (Resident-A), 10-10 (Resident-B), and 10-11 (Farmer). Respective infant hazard quotients are summarized in Tables 10-12 through 10-14. A comparison of the hazard quotients and indices are summarized in Table 10-16.

Hazard indices for adults, children, and infants were less than unity in each of the four scenarios (Table 10-16). Under base case emissions conditions, therefore, noncarcinogenic health effects would not be anticipated in any maximum exposed individual.

10.3.3 Summary of Results

Figure 10-1 illustrates the ranking of the four scenarios relative to the magnitude of carcinogenic risk. The most reasonably maximum exposed individual under base case conditions was the Resident-A child. However, carcinogenic risk was almost two orders of magnitude (i.e., 66 fold) below the level of concern. The inhalation pathway was the primary contributor to total risk for the child. Similarly, the Resident-A child was the most-

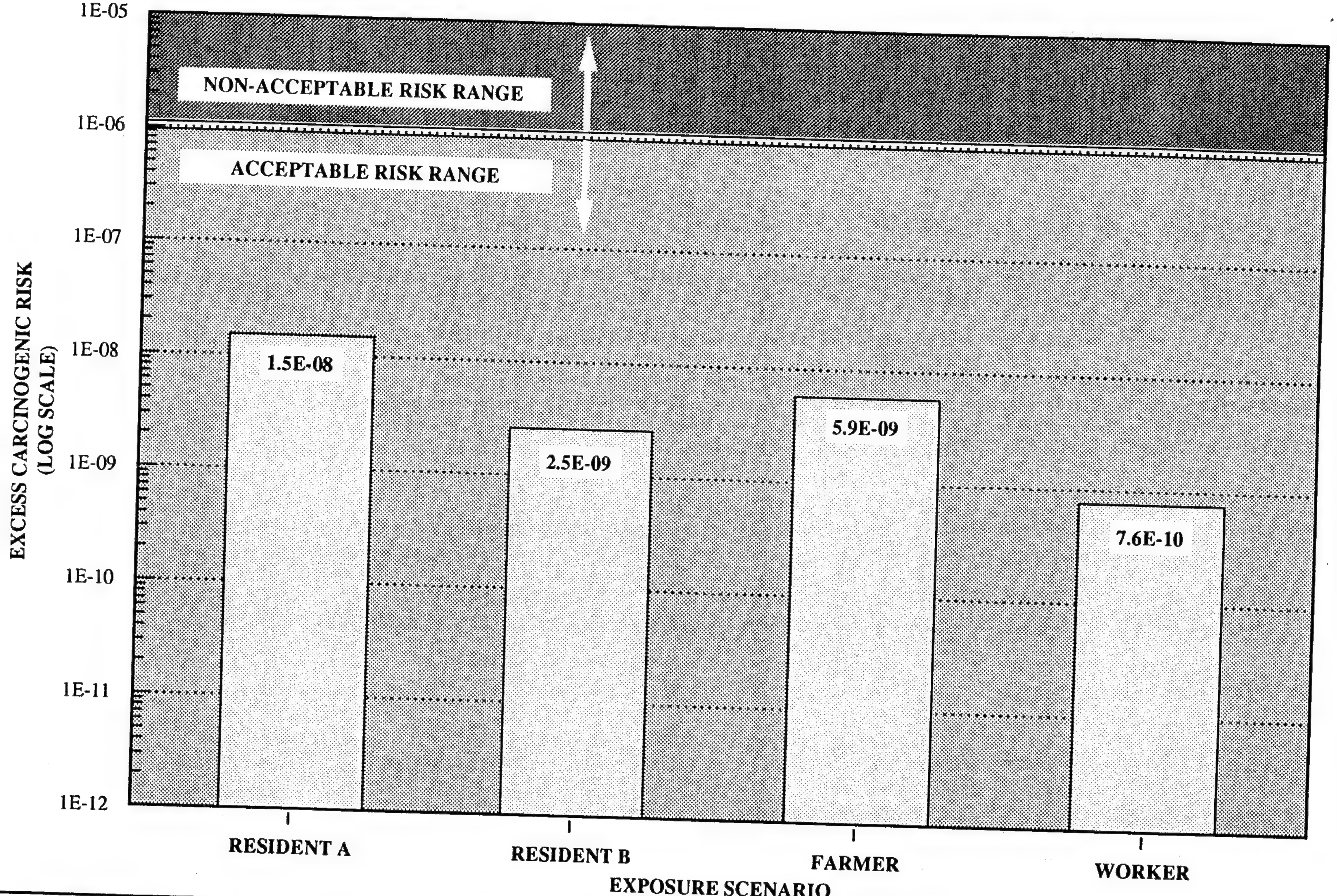

FIGURE 10-1 TOTAL LIFETIME CARCINOGENIC RISK FOR RESIDENT, FARMER AND ON-SITE WORKER EXPOSURE SCENARIOS.(BASE CASE EMISSIONS RATE)

exposed individual in terms of noncarcinogenic health risk (see Figure 10-2). Again, inhalation exposure was the primary contributor.

Based upon a comprehensive multipathway human health risk assessment of the SQI, with four possible exposure scenarios and under conditions of average expected emission rates over the assumed 2-year incinerator operation, it was concluded that the facility poses neither carcinogenic risk nor noncarcinogenic health effects to any sensitive population, as defined by EPA guidance (EPA, 1989) and the Final Decision Document (Woodward-Clyde, 1990).

A sensitivity analysis and discussion of the uncertainties and assumptions underlying these findings are presented in Section 11. As part of the sensitivity analysis, the maximum expected emissions were evaluated on carcinogenic risk and noncarcinogenic health effects.

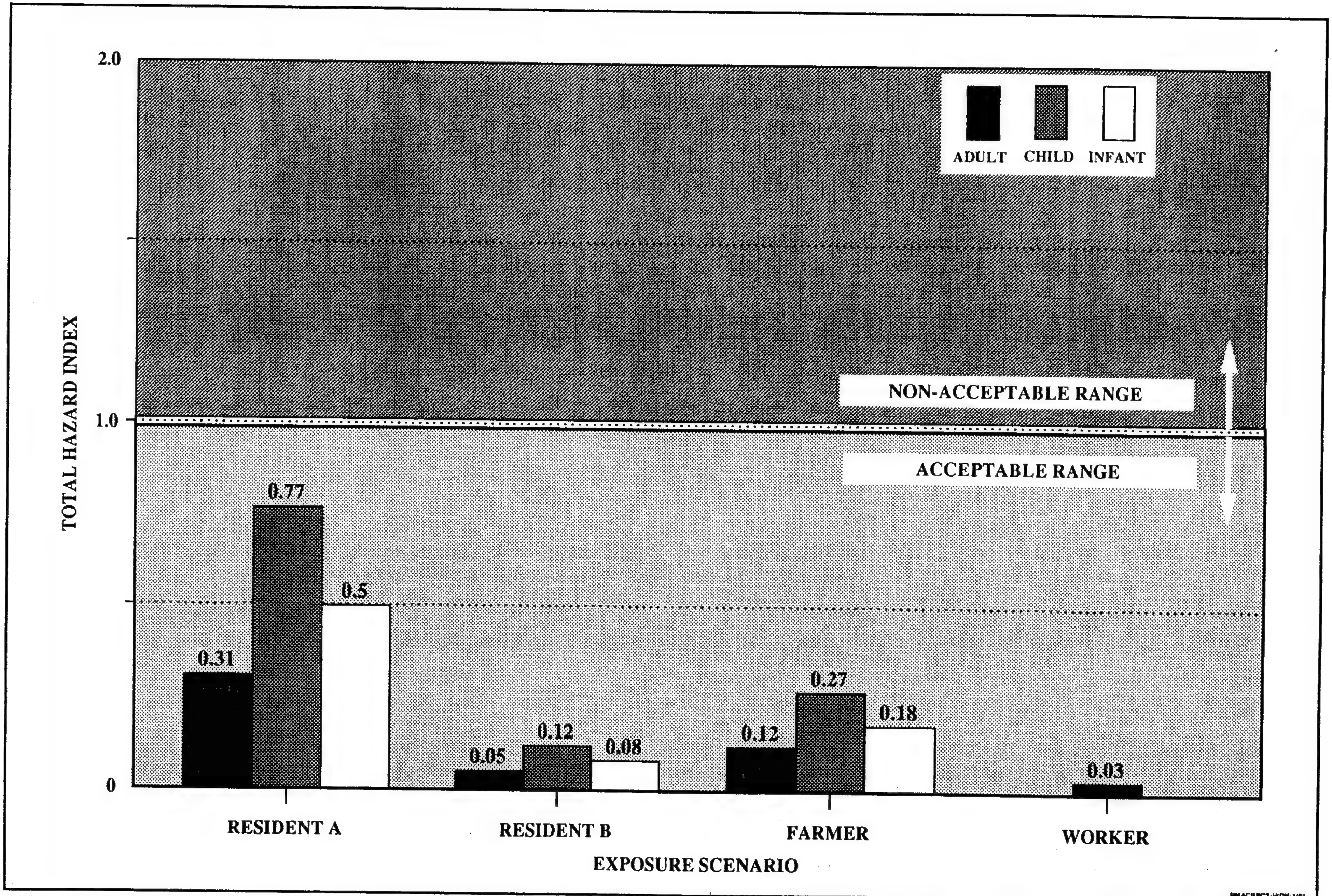

FIGURE 10-2 HAZARD INDICES FOR RESIDENT, FARMER AND ON-SITE WORKER EXPOSURE SCENARIOS. (BASE CASE EMISSIONS RATE)

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Table 10-1

Total Lifetime Resident-A Carcinogenic Risk Through the Inhalation, Ingestion, and Dermal Routes of Exposure

	Exposure Routes									
Pollutant	Inhalation	Mother's Milk Ingestion	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
ORGANICS									
Acrylonitrile	3.92E-18	1.08E-20	NA	NA	NA	NA	NA	NA	3.93E-18
Aldrin	2.94E-17	3.78E-17	1.13E-16	1.88E-18	2.21E-19	4.57E-19	3.81E-21	2.81E-20	1.82E-16
Benzene	1.01E-15	4.64E-19	NA	NA	NA	NA	NA	NA	1.01E-15
Carbazole	6.54E-20	6.64E-20	2.00E-20	8.96E-24	2.83E-24	1.01E-21	2.74E-22	6.23E-23	1.53E-19
Carbon Tetrachloride	1.41E-18	9.68E-21	NA	NA	NA	NA	NA	NA	1.42E-18
Chloroform	1.39E-19	7.19E-23	NA	NA	NA	NA	NA	NA	1.39E-19
p,p-DDE	9.79E-16	8.95E-16	1.55E-17	1.33E-18	1.80E-19	2.83E-18	2.33E-16	1.74E-19	2.13E-15
p,p-DDT	1.96E-19	9.12E-20	1.16E-20	1.11E-21	1.24E-22	5.67E-22	4.86E-20	3.49E-23	3.49E-19
1,4-Dichlorobenzene	9.29E-21	6.38E-23	NA	NA	NA	NA	NA	NA	9.36E-21
1,1-Dichloroethene	1.14E-17	3.92E-20	NA	NA	NA	NA	NA	NA	1.15E-17
1,2-Dichloropropane	5.25E-20	3.60E-22	NA	NA	NA	NA	NA	NA	5.28E-20
Dieldrin	5.68E-18	1.33E-17	1.46E-16	3.30E-20	5.94E-21	8.82E-20	1.53E-19	5.42E-21	1.65E-16
Dioxins/Furans (EPA TEFs)	1.18E-10	1.25E-09	2.77E-12	4.28E-13	1.83E-13	5.95E-13	3.61E-12	3.66E-14	1.38E-09
Hexachlorobenzene	1.86E-16	4.25E-17	8.35E-18	1.49E-19	1.96E-20	3.60E-19	7.58E-18	2.21E-20	2.45E-16
Methyl Chloride	2.15E-16	3.04E-18	NA	NA	NA	NA	NA	NA	2.18E-16
Methylene Chloride	4.77E-17	1.75E-19	NA	NA	NA	NA	NA	NA	4.79E-17
PAHs									
Benzo(a)pyrene	2.07E-14	3.95E-14	5.80E-16	2.34E-16	2.21E-17	1.07E-17	1.56E-16	6.57E-19	6.12E-14
Chrysene	2.07E-14	3.95E-14	6.64E-16	5.58E-17	5.44E-18	1.34E-17	3.95E-15	8.23E-19	6.49E-14
Dibenzo(a,h)anthracene	2.07E-14	4.38E-14	5.93E-16	2.82E-16	2.67E-17	1.45E-17	8.85E-14	8.93E-19	1.54E-13
Parathion	NE	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	9.76E-17	1.02E-16	9.36E-17	3.86E-21	1.24E-21	1.51E-18	1.58E-19	9.30E-20	2.95E-16
Styrene	6.83E-17	7.03E-18	NA	NA	NA	NA	NA	NA	7.53E-17
Tetrachloroethene	4.47E-19	4.75E-20	NA	NA	NA	NA	NA	NA	4.95E-19
Trichloroethene	2.29E-19	1.58E-21	NA	NA	NA	NA	NA	NA	2.31E-19
Vapona	4.46E-19	4.69E-19	4.63E-19	9.54E-24	3.07E-24	6.91E-21	2.75E-22	4.25E-22	1.39E-18
Vinyl Chloride	5.01E-15	5.38E-16	NA	NA	NA	NA	NA	NA	5.55E-15
INORGANICS									
Arsenic	1.35E-08	NE	2.55E-11	1.67E-11	1.79E-13	2.44E-11	2.81E-11	1.50E-12	1.36E-08
Beryllium	7.71E-11	NE	5.92E-13	1.18E-17	4.69E-16	6.12E-13	3.55E-14	3.76E-14	7.84E-11
Cadmium	1.59E-10	NA	NA	NA	NA	NA	NA	NA	1.59E-10
Chromium (VI)	8.61E-11	NA	NA	NA	NA	NA	NA	NA	8.61E-11
Lead	NE	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	1.43E-10	NA	NA	NA	NA	NA	NA	NA	1.43E-10
Total	1.40E-08	1.25E-09	2.88E-11	1.71E-11	3.63E-13	2.56E-11	3.18E-11	1.57E-12	1.54E-08

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Table 10-2

Total Lifetime Resident-B Carcinogenic Risk Through the Inhalation, Ingestion, and Dermal Routes of Exposure

Pollutant	Inhalation	Mother's Milk Ingestion	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
	Exposure Routes								
ORGANICS									
Acrylonitrile	6.14E-19	1.69E-21	NA	NA	NA	NA	NA	NA	6.16E-19
Aldrin	4.61E-18	1.56E-17	1.62E-16	1.88E-18	2.21E-19	6.60E-19	3.81E-21	4.06E-20	1.85E-16
Benzene	1.59E-16	7.27E-20	NA	NA	NA	NA	NA	NA	1.59E-16
Carbazole	1.02E-20	1.17E-20	2.77E-20	8.96E-24	2.83E-24	1.47E-21	2.74E-22	9.01E-23	5.15E-20
Carbon Tetrachloride	2.21E-19	1.52E-21	NA	NA	NA	NA	NA	NA	2.22E-19
Chloroform	2.18E-20	1.13E-23	NA	NA	NA	NA	NA	NA	2.18E-20
p,p-DDE	1.53E-16	1.51E-16	3.76E-18	1.33E-18	1.80E-19	4.10E-18	2.33E-16	2.52E-19	5.46E-16
p,p-DDT	3.07E-20	1.71E-20	1.31E-20	1.11E-21	1.24E-22	8.20E-22	4.86E-20	5.04E-23	1.12E-19
1,4-Dichlorobenzene	1.45E-21	9.99E-24	NA	NA	NA	NA	NA	NA	1.46E-21
1,1-Dichloroethene	1.79E-18	6.15E-21	NA	NA	NA	NA	NA	NA	1.80E-18
1,2-Dichloropropane	8.22E-21	5.64E-23	NA	NA	NA	NA	NA	NA	8.27E-21
Dieldrin	8.90E-19	1.18E-17	2.11E-16	3.30E-20	5.94E-21	1.28E-19	1.53E-19	7.83E-21	2.24E-16
Dioxins/Furans (EPA TEFs)	1.85E-11	2.04E-10	1.02E-12	4.28E-13	1.83E-13	8.61E-13	3.61E-12	5.29E-14	2.28E-10
Hexachlorobenzene	2.91E-17	7.37E-18	8.53E-18	1.49E-19	1.96E-20	5.21E-19	7.58E-18	3.20E-20	5.33E-17
Methyl Chloride	3.36E-17	4.76E-19	NA	NA	NA	NA	NA	NA	3.41E-17
Methylene Chloride	7.47E-18	2.75E-20	NA	NA	NA	NA	NA	NA	7.50E-18
PAHs									
Benzo(a)pyrene	3.25E-15	6.50E-15	9.27E-17	2.34E-16	2.21E-17	1.55E-17	1.56E-16	9.49E-19	1.03E-14
Chrysene	3.25E-15	6.57E-15	2.14E-16	5.58E-17	5.44E-18	1.94E-17	3.95E-15	1.19E-18	1.41E-14
Dibenzo(a,h)anthracene	3.25E-15	1.09E-14	1.12E-16	2.82E-16	2.67E-17	2.10E-17	8.85E-14	1.29E-18	1.03E-13
Parathion	NE	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	1.53E-17	2.21E-17	1.33E-16	3.86E-21	1.24E-21	2.19E-18	1.58E-19	1.35E-19	1.73E-16
Styrene	1.07E-17	1.10E-18	NA	NA	NA	NA	NA	NA	1.18E-17
Tetrachloroethene	7.01E-20	7.44E-21	NA	NA	NA	NA	NA	NA	7.75E-20
Trichloroethene	3.59E-20	2.47E-22	NA	NA	NA	NA	NA	NA	3.62E-20
Vapona	6.98E-20	1.03E-19	6.62E-19	9.54E-24	3.07E-24	9.99E-21	2.75E-22	6.14E-22	8.45E-19
Vinyl Chloride	7.84E-16	8.43E-17	NA	NA	NA	NA	NA	NA	8.68E-16
INORGANICS									
Arsenic	2.11E-09	NE	6.89E-12	1.67E-11	1.79E-13	3.52E-11	2.81E-11	2.16E-12	2.20E-09
Beryllium	1.21E-11	NE	1.04E-13	1.18E-17	4.69E-16	8.85E-13	3.55E-14	5.44E-14	1.32E-11
Cadmium	2.50E-11	NA	NA	NA	NA	NA	NA	NA	2.50E-11
Chromium (VI)	1.35E-11	NA	NA	NA	NA	NA	NA	NA	1.35E-11
Lead	NE	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	2.24E-11	NA	NA	NA	NA	NA	NA	NA	2.24E-11
Total	2.20E-09	2.04E-10	8.01E-12	1.71E-11	3.63E-13	3.70E-11	3.18E-11	2.27E-12	2.50E-09

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Table 10-3

Total Lifetime Farmer Carcinogenic Risk Through the Inhalation, Ingestion, and Dermal Routes of Exposure

Pollutant	Inhalation	Mother's Milk Ingestion	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total
	Exposure Routes								
ORGANICS									
Acrylonitrile	1.38E-18	3.78E-21	NA	NA	NA	NA	NA	NA	1.38E-18
Aldrin	1.03E-17	1.05E-16	8.71E-16	3.76E-17	4.43E-18	3.91E-19	3.81E-21	1.24E-19	1.03E-15
Benzene	3.56E-16	1.63E-19	NA	NA	NA	NA	NA	NA	3.56E-16
Carbazole	2.29E-20	2.93E-20	1.21E-19	1.79E-22	5.66E-23	8.69E-22	2.74E-22	2.75E-22	1.75E-19
Carbon Tetrachloride	4.95E-19	3.40E-21	NA	NA	NA	NA	NA	NA	4.98E-19
Chloroform	4.88E-20	2.52E-23	NA	NA	NA	NA	NA	NA	4.88E-20
p,p-DDE	3.43E-16	3.57E-16	1.40E-17	2.66E-17	3.59E-18	2.43E-18	2.33E-16	7.69E-19	9.80E-16
p,p-DDT	6.88E-20	5.42E-20	6.92E-20	2.22E-20	2.48E-21	4.86E-22	4.86E-20	1.54E-22	2.66E-19
1,4-Dichlorobenzene	3.26E-21	2.24E-23	NA	NA	NA	NA	NA	NA	3.28E-21
1,1-Dichloroethene	4.01E-18	1.38E-20	NA	NA	NA	NA	NA	NA	4.02E-18
1,2-Dichloropropane	1.84E-20	1.26E-22	NA	NA	NA	NA	NA	NA	1.85E-20
Dieldrin	1.99E-18	5.86E-17	1.13E-15	6.59E-19	1.19E-19	7.56E-20	1.53E-19	2.39E-20	1.19E-15
Dioxins/Furans (EPA TEFs)	4.14E-11	5.60E-10	4.60E-12	8.55E-12	3.65E-12	5.10E-13	3.61E-12	1.62E-13	6.22E-10
Hexachlorobenzene	6.52E-17	1.93E-17	4.47E-17	2.99E-18	3.93E-19	3.09E-19	7.58E-18	9.77E-20	1.41E-16
Methyl Chloride	7.53E-17	1.07E-18	NA	NA	NA	NA	NA	NA	7.64E-17
Methylene Chloride	1.67E-17	6.16E-20	NA	NA	NA	NA	NA	NA	1.68E-17
PAHs									
Benzo(a)pyrene	7.28E-15	2.12E-14	3.69E-16	4.69E-15	4.41E-16	9.16E-18	1.56E-16	2.90E-18	3.41E-14
Chrysene	7.28E-15	1.67E-14	1.01E-15	1.12E-15	1.09E-16	1.15E-17	3.95E-15	3.63E-18	3.02E-14
Dibenzo(a,h)anthracene	7.28E-15	2.70E-14	4.70E-16	5.65E-15	5.34E-16	1.25E-17	8.85E-14	3.94E-18	1.29E-13
Parathion	NE	NE	NE	NE	NE	NE	NE	NE	NE
Quinoline	3.43E-17	5.92E-17	4.95E-16	7.71E-20	2.48E-20	1.30E-18	1.58E-19	4.11E-19	5.90E-16
Styrene	2.40E-17	2.47E-18	NA	NA	NA	NA	NA	NA	2.64E-17
Tetrachloroethene	1.57E-19	1.67E-20	NA	NA	NA	NA	NA	NA	1.74E-19
Trichloroethene	8.05E-20	5.53E-22	NA	NA	NA	NA	NA	NA	8.11E-20
Vapona	1.56E-19	2.18E-19	1.21E-18	1.91E-22	6.15E-23	5.93E-21	2.75E-22	1.88E-21	1.59E-18
Vinyl Chloride	1.76E-15	1.89E-16	NA	NA	NA	NA	NA	NA	1.95E-15
INORGANICS									
Arsenic	4.72E-09	NE	1.82E-11	3.34E-10	3.59E-12	2.09E-11	2.81E-11	6.61E-12	5.13E-09
Beryllium	2.71E-11	NE	3.46E-13	2.37E-16	9.39E-15	5.25E-13	3.55E-14	1.66E-13	2.81E-11
Cadmium	5.60E-11	NA	NA	NA	NA	NA	NA	NA	5.60E-11
Chromium (VI)	3.02E-11	NA	NA	NA	NA	NA	NA	NA	3.02E-11
Lead	NE	NE	NE	NE	NE	NE	NE	NE	NE
Nickel	5.03E-11	NA	NA	NA	NA	NA	NA	NA	5.03E-11
Total	4.93E-09	5.60E-10	2.31E-11	3.42E-10	7.25E-12	2.19E-11	3.18E-11	6.94E-12	5.92E-09

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Table 10-4

Total Lifetime Worker Carcinogenic Risk Through the Inhalation, Ingestion, and Dermal Routes of Exposure

Pollutant	Exposure Routes: Inhalation	Soil/Dust Ingestion	Dermal Absorption	Total
ORGANICS				
Acrylonitrile	2.11E-19	NA	NA	2.11E-19
Aldrin	1.59E-18	5.07E-20	7.85E-20	1.71E-18
Benzene	5.46E-17	NA	NA	5.46E-17
Carbazole	3.52E-21	1.13E-22	1.74E-22	3.81E-21
Carbon Tetrachloride	7.60E-20	NA	NA	7.60E-20
Chloroform	7.49E-21	NA	NA	7.49E-21
p,p-DDE	5.27E-17	3.15E-19	4.87E-19	5.35E-17
p,p-DDT	1.06E-20	6.30E-23	9.75E-23	1.07E-20
1,4-Dichlorobenzene	5.01E-22	NA	NA	5.01E-22
1,1-Dichloroethene	6.16E-19	NA	NA	6.16E-19
1,2-Dichloropropane	2.83E-21	NA	NA	2.83E-21
Dieldrin	3.06E-19	9.80E-21	1.52E-20	3.31E-19
Dioxins/Furans (EPA TEFs)	6.35E-12	6.62E-14	1.02E-13	6.52E-12
Hexachlorobenzene	1.00E-17	4.00E-20	6.19E-20	1.01E-17
Methyl Chloride	1.16E-17	NA	NA	1.16E-17
Methylene Chloride	2.57E-18	NA	NA	2.57E-18
PAHs				
Benzo(a)pyrene	1.12E-15	1.19E-18	1.84E-18	1.12E-15
Chrysene	1.12E-15	1.49E-18	2.30E-18	1.12E-15
Dibenzo(a,h)anthracene	1.12E-15	1.61E-18	2.50E-18	1.12E-15
Parathion	NE	NE	NE	NE
Quinoline	5.26E-18	1.68E-19	2.60E-19	5.69E-18
Styrene	3.68E-18	NA	NA	3.68E-18
Tetrachloroethene	2.41E-20	NA	NA	2.41E-20
Trichloroethene	1.24E-20	NA	NA	1.24E-20
Vapona	2.40E-20	7.68E-22	1.19E-21	2.60E-20
Vinyl Chloride	2.70E-16	NA	NA	2.70E-16
INORGANICS				
Arsenic	7.25E-10	2.71E-12	4.18E-12	7.32E-10
Beryllium	4.15E-12	6.80E-14	1.05E-13	4.33E-12
Cadmium	8.59E-12	NA	NA	8.59E-12
Chromium (VI)	4.64E-12	NA	NA	4.64E-12
Lead	NE	NE	NE	NE
Nickel	7.72E-12	NA	NA	7.72E-12
Total	7.56E-10	2.84E-12	4.39E-12	7.64E-10

Table 10-5

Adult Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposure for the Resident-A Scenario

Pollutant	Exposure Routes							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
ORGANICS								
Acetone	2.77E-17	NA	NA	NA	NA	NA	NA	2.77E-17
Acetonitrile	3.06E-13	4.80E-14	8.33E-21	3.25E-21	2.75E-17	1.40E-20	1.15E-18	3.54E-13
Acrylonitrile	6.97E-14	NA	NA	NA	NA	NA	NA	6.97E-14
Aldrin	1.27E-13	2.47E-13	8.67E-14	9.81E-15	5.82E-16	6.95E-18	2.43E-17	4.71E-13
Atrazine	1.41E-15	4.96E-17	3.65E-21	8.17E-22	2.61E-19	0.00E+00	1.09E-20	1.46E-15
Benzaldehyde	6.64E-12	4.91E-13	6.89E-18	2.52E-18	3.58E-15	2.31E-16	1.49E-16	7.14E-12
Benzene	2.01E-11	NA	NA	NA	NA	NA	NA	2.01E-11
Benzofuran	2.55E-10	1.31E-11	1.14E-15	3.40E-16	1.37E-13	3.99E-14	5.73E-15	2.68E-10
Benzoic Acid	8.05E-14	4.57E-15	1.29E-19	4.54E-20	4.33E-17	5.02E-18	1.81E-18	8.51E-14
Benzonitrile	3.83E-14	2.66E-15	4.33E-20	1.58E-20	2.06E-17	1.48E-18	8.59E-19	4.10E-14
Biphenyl	2.40E-10	NA	NA	NA	NA	NA	NA	2.40E-10
Bromomethane	3.73E-12	NA	NA	NA	NA	NA	NA	3.73E-12
Carbazole	1.22E-14	5.07E-16	1.42E-19	3.45E-20	6.60E-18	2.55E-18	2.75E-19	1.28E-14
Carbon Tetrachloride	6.43E-15	NA	NA	NA	NA	NA	NA	6.43E-15
Chlorobenzene	3.15E-11	NA	NA	NA	NA	NA	NA	3.15E-11
4-Chlorobiphenyl	1.51E-11	4.90E-13	4.21E-15	5.80E-16	8.13E-15	2.29E-15	3.40E-16	1.56E-11
4,4-Chlorobiphenyl	2.08E-13	6.41E-15	2.62E-16	3.22E-17	1.12E-16	1.05E-17	4.69E-18	2.15E-13
Chloroform	6.44E-16	NA	NA	NA	NA	NA	NA	6.44E-16
4-Chlorophenylmethylsulfone	5.97E-15	3.66E-16	2.61E-21	9.40E-22	1.73E-18	1.49E-19	7.22E-20	6.34E-15
4-Chlorophenylmethylsulfoxide	2.22E-14	1.29E-15	1.13E-20	3.99E-21	6.45E-18	5.49E-19	2.69E-19	2.35E-14
p,p-DDE	1.08E-10	2.85E-12	1.74E-13	2.10E-14	5.37E-14	1.27E-12	2.24E-15	1.12E-10
p,p-DDT	1.06E-14	8.16E-16	1.60E-16	1.85E-17	1.07E-17	2.66E-16	4.48E-19	1.19E-14
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	2.87E-15	NA	NA	NA	NA	NA	NA	2.87E-15
1,1-Dichloroethene	8.75E-15	NA	NA	NA	NA	NA	NA	8.75E-15
1,2-Dichloroethene	6.21E-15	NA	NA	NA	NA	NA	NA	6.21E-15
1,2-Dichloropropane	4.09E-17	NA	NA	NA	NA	NA	NA	4.09E-17
Dieldrin	2.61E-14	1.84E-13	6.84E-16	8.00E-17	7.17E-17	1.78E-16	2.99E-18	2.12E-13
Diisopropyl Methylphosphonate	1.46E-14	7.58E-16	1.51E-20	5.22E-21	5.66E-18	7.01E-19	2.36E-19	1.54E-14
1,3-Dimethylbenzene	6.38E-13	1.08E-13	2.55E-17	6.41E-18	1.37E-15	5.17E-16	5.73E-17	7.48E-13
Dimethyldisulfide	4.01E-13	NA	NA	NA	NA	NA	NA	4.01E-13
Dimethyl Methylphosphonate	1.55E-12	1.79E-13	1.41E-21	5.35E-22	1.98E-17	1.71E-17	8.26E-19	1.73E-12
Dimethylphosphate	8.78E-14	2.29E-15	NE	NE	4.73E-17	NE	1.97E-18	9.01E-14
Dioxins/Furans (EPA TEFs)	1.95E-05	5.22E-07	6.26E-08	2.56E-08	9.91E-09	2.24E-08	4.13E-10	2.02E-05
Dithiane	1.17E-16	1.66E-17	5.76E-23	2.20E-23	6.30E-20	1.49E-21	2.63E-21	1.34E-16
Endrin	6.35E-14	5.75E-16	2.87E-18	4.25E-19	1.08E-17	4.19E-18	4.51E-19	6.41E-14
Ethylbenzene	4.32E-13	NA	NA	NA	NA	NA	NA	4.32E-13
Hexachlorobenzene	2.72E-12	1.02E-13	2.66E-15	3.29E-16	1.30E-15	5.51E-15	5.43E-17	2.83E-12
Hexachlorocyclopentadiene	3.02E-12	1.45E-15	9.27E-18	1.15E-18	4.64E-18	9.93E-19	1.93E-19	3.02E-12
Isodrin	2.44E-13	1.75E-13	2.54E-15	2.93E-16	1.31E-16	2.92E-15	5.47E-18	4.24E-13

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Table 10-5
(continued)

Malathion	2.55E-15	4.68E-17	8.01E-21	2.24E-21	7.02E-19	0.00E+00	2.93E-20	2.60E-15
Methanol	2.77E-12	1.42E-12	1.51E-19	5.91E-20	7.97E-16	1.90E-17	3.32E-17	4.19E-12
Methyl Chloride	6.08E-12	NA	NA	NA	NA	NA	NA	6.08E-12
Methylene Chloride	7.45E-14	NA	NA	NA	NA	NA	NA	7.45E-14
4-Nitrophenol	1.08E-13	5.01E-15	6.84E-19	1.90E-19	5.81E-17	1.96E-17	2.42E-18	1.13E-13
PAHs								
Acenaphthalene	5.32E-12	2.60E-13	2.60E-16	4.63E-17	2.87E-15	1.58E-15	1.19E-16	5.58E-12
Acenaphthene	5.32E-12	1.94E-13	1.94E-16	3.66E-17	2.87E-15	6.13E-16	1.19E-16	5.52E-12
Benzo(a)pyrene	2.12E-12	5.61E-14	1.79E-14	2.04E-15	5.60E-16	4.21E-16	2.34E-17	2.20E-12
Chrysene	2.12E-12	6.21E-14	4.24E-15	4.95E-16	6.36E-16	1.06E-14	2.65E-17	2.20E-12
Dibenzo(a,h)anthracene	2.12E-12	5.69E-14	2.15E-14	2.45E-15	6.62E-16	2.39E-13	2.76E-17	2.44E-12
Fluoranthene	4.79E-12	1.54E-13	2.62E-15	3.19E-16	1.41E-15	NA	5.89E-17	4.95E-12
Fluorene	1.59E-12	6.30E-14	1.46E-16	2.33E-17	8.58E-16	6.59E-16	3.58E-17	1.66E-12
Phenanthrene	4.25E-12	1.30E-13	5.38E-16	7.03E-17	1.02E-15	2.95E-15	4.27E-17	4.39E-12
Pyrene	2.12E-12	6.49E-14	1.05E-15	1.27E-16	5.01E-16	2.42E-15	2.09E-17	2.19E-12
Parathion	7.05E-14	2.22E-17	1.77E-20	3.49E-21	3.23E-19	1.09E-19	1.35E-20	7.05E-14
Pentachlorobenzene	1.22E-12	6.19E-14	5.03E-16	6.67E-17	6.55E-16	NA	2.73E-17	1.28E-12
Phenol	1.78E-10	1.02E-12	5.84E-18	2.14E-18	3.10E-15	3.50E-17	1.29E-16	1.79E-10
Pyridine	1.88E-15	NA	NA	NA	NA	NA	NA	1.88E-15
Quinoline	7.62E-16	5.74E-17	1.48E-21	5.08E-22	4.11E-19	6.11E-20	1.71E-20	8.20E-16
Styrene	2.95E-12	NA	NA	NA	NA	NA	NA	2.95E-12
Supona	7.20E-14	2.84E-15	6.23E-19	1.62E-19	3.88E-17	1.42E-17	1.62E-18	7.49E-14
Tetrachlorobenzene	1.37E-12	1.15E-13	1.23E-16	1.97E-17	7.37E-16	NA	3.07E-17	1.48E-12
Tetrachloroethene	7.34E-15	NA	NA	NA	NA	NA	NA	7.34E-15
Toluene	5.59E-13	NA	NA	NA	NA	NA	NA	5.59E-13
Trichlorobenzene	7.21E-14	3.50E-16	4.43E-19	8.16E-20	5.82E-18	4.78E-18	2.43E-19	7.25E-14
Trichloroethene	1.43E-15	NA	NA	NA	NA	NA	NA	1.43E-15
Urea	5.52E-11	8.88E-10	7.03E-19	2.76E-19	2.97E-14	7.09E-16	1.23E-15	9.43E-10
Vapona	3.60E-14	2.83E-15	3.42E-20	1.26E-20	1.94E-17	1.10E-18	8.08E-19	3.88E-14
Vinyl Chloride	4.80E-11	NA	NA	NA	NA	NA	NA	4.80E-11
Xylene	1.49E-12	NA	NA	NA	NA	NA	NA	1.49E-12
INORGANICS								
Aluminum	4.14E-05	NA	NA	NA	NA	NE	NA	4.14E-05
Ammonia	8.81E-07	NA	NA	NA	NA	NA	NA	8.81E-07
Antimony	5.82E-06	1.97E-07	3.04E-10	1.24E-10	4.00E-09	NA	1.67E-10	6.03E-06
Arsenic	8.24E-05	4.40E-07	4.56E-08	5.59E-10	9.05E-09	1.49E-08	3.77E-10	8.29E-05
Barium	4.12E-05	1.55E-09	8.69E-12	1.44E-13	3.17E-11	NE	1.32E-12	4.12E-05
Beryllium	8.43E-05	8.97E-10	1.22E-14	4.94E-13	1.85E-11	1.53E-12	7.72E-13	8.43E-05
Boron	3.05E-05	NA	NA	NA	NA	NE	NA	3.05E-05
Cadmium	9.61E-06	NA	NA	NA	NA	3.78E-10	NA	9.61E-06
Calcium	4.93E-04	NA	NA	NA	NA	NA	NA	4.93E-04
Chromium (III)	2.19E-06	NA	NA	NA	NA	NA	NA	2.19E-06
Chromium (VI)	7.71E-07	NA	NA	NA	NA	2.86E-12	NA	7.71E-07
Cobalt	7.26E-05	NA	NA	NA	NA	7.55E-11	NA	7.26E-05
Copper	1.58E-03	1.18E-05	3.40E-07	1.28E-07	2.23E-07	1.18E-06	9.32E-09	1.59E-03
Cyanogen	1.43E-15	NA	NA	NA	NA	NA	NA	1.43E-15
Hydrogen Cyanide	5.93E-11	NA	NA	NA	NA	NA	NA	5.93E-11
Iron	2.20E-04	NA	NA	NA	NA	NE	NA	2.20E-04
Lead	1.23E-05	9.87E-08	3.96E-10	1.90E-11	2.03E-09	1.63E-09	8.46E-11	1.24E-05

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Table 10-5
(continued)

Lithium	5.16E-06	NA	NA	NA	NA	NE	NA	5.16E-06
Magnesium	1.09E-04	NA	NA	NA	NA	NE	NA	1.09E-04
Manganese	9.64E-05	NA	NA	NA	NA	NE	NA	9.64E-05
Mercury	5.43E-05	4.42E-07	3.58E-09	1.22E-07	8.35E-09	NA	3.48E-10	5.48E-05
Molybdenum	1.01E-05	NA	NA	NA	NA	NE	NA	1.01E-05
Nickel	1.32E-03	NA	NA	NA	NA	NA	NA	1.32E-03
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	2.11E-01	3.78E-04	2.63E-05	3.93E-06	7.74E-06	5.83E-07	3.23E-07	2.12E-01
Silicon	1.46E-02	NA	NA	NA	NA	NA	NA	1.46E-02
Silver	4.38E-02	4.06E-06	1.50E-06	1.11E-08	8.02E-08	1.15E-06	3.34E-09	4.38E-02
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	4.25E-04	1.62E-05	4.86E-07	3.53E-07	3.34E-07	NA	1.39E-08	4.43E-04
Tin	1.86E-05	NA	NA	NA	NA	NE	NA	1.86E-05
Titanium	4.69E-08	NA	NA	NA	NA	NE	NA	4.69E-08
Vanadium	2.15E-04	NA	NA	NA	NA	3.68E-11	NA	2.15E-04
Yittrium	9.84E-08	NA	NA	NA	NA	NE	NA	9.84E-08
Zinc	9.32E-06	NA	NA	NA	NA	5.30E-10	NA	9.32E-06
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	3.81E-04	NA	NA	NA	NA	NA	NA	3.81E-04
Hydrogen Chloride	2.90E-03	NA	NA	NA	NA	NA	NA	2.90E-03
Hydrogen Fluorides	2.95E-04	NA	NA	NA	NA	NA	NA	2.95E-04
Nitric Acid	3.44E-03	NA	NA	NA	NA	NA	NA	3.44E-03
Nitrogen Dioxide	5.28E-03	NA	NA	NA	NA	NA	NA	5.28E-03
Particulate Matter	1.52E-03	NA	NA	NA	NA	NA	NA	1.52E-03
Sulfur Dioxide	5.01E-03	NA	NA	NA	NA	NA	NA	5.01E-03
Sulfuric Acid Mist	4.73E-02	NA	NA	NA	NA	NA	NA	4.73E-02
Total (Hazard Index)	3.41E-01	4.12E-04	2.88E-05	4.57E-06	8.41E-06	2.95E-06	3.51E-07	3.41E-01

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Table 10-6

Adult Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposures for the Resident-B Scenario

Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
	Exposure Routes							
ORGANICS								
Acetone	4.34E-18	NA	NA	NA	NA	NA	NA	4.34E-18
Acetonitrile	4.79E-14	6.76E-14	8.33E-21	3.25E-21	3.97E-17	1.40E-20	1.66E-18	1.16E-13
Acrylonitrile	1.09E-14	NA	NA	NA	NA	NA	NA	1.09E-14
Aldrin	1.99E-14	3.20E-13	8.67E-14	9.81E-15	8.42E-16	6.95E-18	3.51E-17	4.37E-13
Atrazine	2.21E-16	2.27E-17	3.65E-21	8.17E-22	3.77E-19	0.00E+00	1.57E-20	2.44E-16
Benzaldehyde	1.04E-12	4.83E-13	6.89E-18	2.52E-18	5.17E-15	2.31E-16	2.16E-16	1.53E-12
Benzene	3.15E-12	NA	NA	NA	NA	NA	NA	3.15E-12
Benzofuran	3.99E-11	1.02E-11	1.14E-15	3.40E-16	1.99E-13	3.99E-14	8.28E-15	5.04E-11
Benzoic Acid	1.26E-14	3.87E-15	1.29E-19	4.54E-20	6.26E-17	5.02E-18	2.61E-18	1.65E-14
Benzonitrile	5.99E-15	2.55E-15	4.33E-20	1.58E-20	2.98E-17	1.48E-18	1.24E-18	8.57E-15
Biphenyl	3.76E-11	NA	NA	NA	NA	NA	NA	3.76E-11
Bromomethane	5.85E-13	NA	NA	NA	NA	NA	NA	5.85E-13
Carbazole	1.92E-15	3.16E-16	1.42E-19	3.45E-20	9.54E-18	2.55E-18	3.98E-19	2.25E-15
Carbon Tetrachloride	1.01E-15	NA	NA	NA	NA	NA	NA	1.01E-15
Chlorobenzene	4.94E-12	NA	NA	NA	NA	NA	NA	4.94E-12
4-Chlorobiphenyl	2.36E-12	1.95E-13	4.21E-15	5.80E-16	1.18E-14	2.29E-15	4.92E-16	2.58E-12
4,4-Chlorobiphenyl	3.26E-14	2.19E-15	2.62E-16	3.22E-17	1.62E-16	1.05E-17	6.78E-18	3.52E-14
Chloroform	1.01E-16	NA	NA	NA	NA	NA	NA	1.01E-16
4-Chlorophenylmethylsulfone	9.36E-16	3.25E-16	2.61E-21	9.40E-22	2.51E-18	1.49E-19	1.04E-19	1.26E-15
4-Chlorophenylmethylsulfoxide	3.48E-15	1.11E-15	1.13E-20	3.99E-21	9.33E-18	5.49E-19	3.89E-19	4.60E-15
p,p-DDE	1.69E-11	4.44E-13	1.74E-13	2.10E-14	7.76E-14	1.27E-12	3.23E-15	1.89E-11
p,p-DDT	1.66E-15	4.45E-16	1.60E-16	1.85E-17	1.55E-17	2.66E-16	6.47E-19	2.56E-15
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	4.49E-16	NA	NA	NA	NA	NA	NA	4.49E-16
1,1-Dichloroethene	1.37E-15	NA	NA	NA	NA	NA	NA	1.37E-15
1,2-Dichloroethene	9.72E-16	NA	NA	NA	NA	NA	NA	9.72E-16
1,2-Dichloropropane	6.40E-18	NA	NA	NA	NA	NA	NA	6.40E-18
Dieldrin	4.09E-15	2.62E-13	6.84E-16	8.00E-17	1.04E-16	1.78E-16	4.32E-18	2.67E-13
Diisopropyl Methylphosphonate	2.29E-15	5.98E-16	1.51E-20	5.22E-21	8.18E-18	7.01E-19	3.41E-19	2.90E-15
1,3-Dimethylbenzene	9.99E-14	6.96E-14	2.55E-17	6.41E-18	1.99E-15	5.17E-16	8.28E-17	1.72E-13
Dimethyldisulfide	6.27E-14	NA	NA	NA	NA	NA	NA	6.27E-14
Dimethyl Methylphosphonate	2.43E-13	2.07E-13	1.41E-21	5.35E-22	2.87E-17	1.71E-17	1.20E-18	4.49E-13
Dimethylphosphate	1.37E-14	3.21E-16	NE	NE	6.84E-17	NE	2.85E-18	1.41E-14
Dioxins/Furans (EPA TEFs)	3.06E-06	8.90E-08	6.26E-08	2.56E-08	1.43E-08	2.24E-08	5.97E-10	3.27E-06
Dithiane	1.83E-17	2.00E-17	5.76E-23	2.20E-23	9.11E-20	1.49E-21	3.80E-21	3.84E-17
Endrin	9.94E-15	9.72E-17	2.87E-18	4.25E-19	1.56E-17	4.19E-18	6.52E-19	1.01E-14
Ethylbenzene	6.77E-14	NA	NA	NA	NA	NA	NA	6.77E-14
Hexachlorobenzene	4.26E-13	5.49E-14	2.66E-15	3.29E-16	1.88E-15	5.51E-15	7.85E-17	4.91E-13

Table 10-6
(continued)

Hexachlorocyclopentadiene	4.72E-13	1.80E-15	9.27E-18	1.15E-18	6.71E-18	9.93E-19	2.80E-19	4.74E-13
Isodrin	3.82E-14	2.44E-13	2.54E-15	2.93E-16	1.90E-16	2.92E-15	7.91E-18	2.88E-13
Malathion	4.00E-16	2.34E-17	8.01E-21	2.24E-21	1.01E-18	0.00E+00	4.23E-20	4.24E-16
Methanol	4.34E-13	2.00E-12	1.51E-19	5.91E-20	1.15E-15	1.90E-17	4.80E-17	2.43E-12
Methyl Chloride	9.52E-13	NA	NA	NA	NA	NA	NA	9.52E-13
Methylene Chloride	1.17E-14	NA	NA	NA	NA	NA	NA	1.17E-14
4-Nitrophenol	1.69E-14	3.58E-15	6.84E-19	1.90E-19	8.40E-17	1.96E-17	3.50E-18	2.06E-14
PAHs								
Acenaphthalene	8.33E-13	1.94E-13	2.60E-16	4.63E-17	4.14E-15	1.58E-15	1.73E-16	1.03E-12
Acenaphthene	8.33E-13	1.00E-13	1.94E-16	3.66E-17	4.14E-15	6.13E-16	1.73E-16	9.38E-13
Benzo(a)pyrene	3.33E-13	8.76E-15	1.79E-14	2.04E-15	8.10E-16	4.21E-16	3.38E-17	3.62E-13
Chrysene	3.33E-13	1.75E-14	4.24E-15	4.95E-16	9.19E-16	1.06E-14	3.83E-17	3.66E-13
Dibenzo(a,h)anthracene	3.33E-13	9.95E-15	2.15E-14	2.45E-15	9.57E-16	2.39E-13	3.99E-17	6.06E-13
Fluoranthene	7.50E-13	5.91E-14	2.62E-15	3.19E-16	2.04E-15	NA	8.52E-17	8.14E-13
Fluorene	2.49E-13	3.69E-14	1.46E-16	2.33E-17	1.24E-15	6.59E-16	5.17E-17	2.88E-13
Phenanthrene	6.66E-13	4.26E-14	5.38E-16	7.03E-17	1.48E-15	2.95E-15	6.17E-17	7.13E-13
Pyrene	3.33E-13	2.16E-14	1.05E-15	1.27E-16	7.25E-16	2.42E-15	3.02E-17	3.58E-13
Parathion	1.10E-14	1.18E-17	1.77E-20	3.49E-21	4.67E-19	1.09E-19	1.95E-20	1.11E-14
Pentachlorobenzene	1.90E-13	4.80E-14	5.03E-16	6.67E-17	9.47E-16	NA	3.95E-17	2.40E-13
Phenol	2.79E-11	1.27E-12	5.84E-18	2.14E-18	4.48E-15	3.50E-17	1.87E-16	2.91E-11
Pyridine	2.94E-16	NA	NA	NA	NA	NA	NA	2.94E-16
Quinoline	1.19E-16	5.71E-17	1.48E-21	5.08E-22	5.94E-19	6.11E-20	2.47E-20	1.77E-16
Styrene	4.62E-13	NA	NA	NA	NA	NA	NA	4.62E-13
Supona	1.13E-14	1.65E-15	6.23E-19	1.62E-19	5.61E-17	1.42E-17	2.34E-18	1.30E-14
Tetrachlorobenzene	2.14E-13	1.19E-13	1.23E-16	1.97E-17	1.07E-15	NA	4.44E-17	3.35E-13
Tetrachloroethene	1.15E-15	NA	NA	NA	NA	NA	NA	1.15E-15
Toluene	8.75E-14	NA	NA	NA	NA	NA	NA	8.75E-14
Trichlorobenzene	1.13E-14	1.39E-16	4.43E-19	8.16E-20	8.42E-18	4.78E-18	3.51E-19	1.14E-14
Trichloroethene	2.23E-16	NA	NA	NA	NA	NA	NA	2.23E-16
Urea	8.65E-12	1.28E-09	7.03E-19	2.76E-19	4.30E-14	7.09E-16	1.77E-15	1.29E-09
Vapona	5.64E-15	2.87E-15	3.42E-20	1.26E-20	2.80E-17	1.10E-18	1.17E-18	8.53E-15
Vinyl Chloride	7.52E-12	NA	NA	NA	NA	NA	NA	7.52E-12
Xylene	2.33E-13	NA	NA	NA	NA	NA	NA	2.33E-13
INORGANICS								
Aluminum	6.49E-06	NA	NA	NA	NA	NE	NA	6.49E-06
Ammonia	1.38E-07	NA	NA	NA	NA	NA	NA	1.38E-07
Antimony	9.12E-07	3.18E-08	3.04E-10	1.24E-10	5.78E-09	NA	2.41E-10	9.50E-07
Arsenic	1.29E-05	6.35E-08	4.56E-08	5.59E-10	1.31E-08	1.49E-08	5.46E-10	1.30E-05
Barium	6.45E-06	2.37E-10	8.69E-12	1.44E-13	4.58E-11	NE	1.91E-12	6.45E-06
Beryllium	1.32E-05	1.27E-10	1.22E-14	4.94E-13	2.68E-11	1.53E-12	1.12E-12	1.32E-05
Boron	4.78E-06	NA	NA	NA	NA	NE	NA	4.78E-06
Cadmium	1.50E-06	NA	NA	NA	NA	3.78E-10	NA	1.50E-06
Calcium	7.73E-05	NA	NA	NA	NA	NA	NA	7.73E-05
Chromium (III)	3.43E-07	NA	NA	NA	NA	NA	NA	3.43E-07
Chromium (VI)	1.21E-07	NA	NA	NA	NA	2.86E-12	NA	1.21E-07
Cobalt	1.14E-05	NA	NA	NA	NA	7.55E-11	NA	1.14E-05
Copper	2.47E-04	2.97E-06	3.40E-07	1.28E-07	3.23E-07	1.18E-06	1.35E-08	2.52E-04
Cyanogen	2.24E-16	NA	NA	NA	NA	NA	NA	2.24E-16
Hydrogen Cyanide	9.28E-12	NA	NA	NA	NA	NA	NA	9.28E-12

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Table 10-6
(continued)

Iron	3.44E-05	NA	NA	NA	NA	NE	NA	3.44E-05
Lead	1.92E-06	1.44E-08	3.96E-10	1.90E-11	2.93E-09	1.63E-09	1.22E-10	1.94E-06
Lithium	8.08E-07	NA	NA	NA	NA	NE	NA	8.08E-07
Magnesium	1.70E-05	NA	NA	NA	NA	NE	NA	1.70E-05
Manganese	1.51E-05	NA	NA	NA	NA	NA	NA	1.51E-05
Mercury	8.50E-06	1.12E-07	3.58E-09	1.22E-07	1.21E-08	NA	5.03E-10	8.75E-06
Molybdenum	1.59E-06	NA	NA	NA	NA	NE	NA	1.59E-06
Nickel	2.06E-04	NA	NA	NA	NA	NA	NA	2.06E-04
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	3.31E-02	5.72E-05	2.63E-05	3.93E-06	1.12E-05	5.83E-07	4.67E-07	3.32E-02
Silicon	2.28E-03	NA	NA	NA	NA	NA	NA	2.28E-03
Silver	6.86E-03	8.00E-07	1.50E-06	1.11E-08	1.16E-07	1.15E-06	4.84E-09	6.86E-03
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	6.66E-05	2.27E-06	4.86E-07	3.53E-07	4.83E-07	NA	2.01E-08	7.02E-05
Tin	2.91E-06	NA	NA	NA	NA	NE	NA	2.91E-06
Titanium	7.35E-09	NA	NA	NA	NA	NE	NA	7.35E-09
Vanadium	3.37E-05	NA	NA	NA	NA	3.68E-11	NA	3.37E-05
Yittrium	1.54E-08	NA	NA	NA	NA	NE	NA	1.54E-08
Zinc	1.46E-06	NA	NA	NA	NA	5.30E-10	NA	1.46E-06
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	5.97E-05	NA	NA	NA	NA	NA	NA	5.97E-05
Hydrogen Chloride	4.53E-04	NA	NA	NA	NA	NA	NA	4.53E-04
Hydrogen Fluorides	4.62E-05	NA	NA	NA	NA	NA	NA	4.62E-05
Nitric Acid	5.39E-04	NA	NA	NA	NA	NA	NA	5.39E-04
Nitrogen Dioxide	8.27E-04	NA	NA	NA	NA	NA	NA	8.27E-04
Particulate Matter	2.38E-04	NA	NA	NA	NA	NA	NA	2.38E-04
Sulfur Dioxide	7.84E-04	NA	NA	NA	NA	NA	NA	7.84E-04
Sulfuric Acid Mist	7.40E-03	NA	NA	NA	NA	NA	NA	7.40E-03
Total (Hazard Index)	5.34E-02	6.36E-05	2.88E-05	4.57E-06	1.22E-05	2.95E-06	5.07E-07	5.35E-02

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Table 10-7

Adult Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposures for the Farmer Scenario

	Exposure Routes							
Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
ORGANICS								
Acetone	9.72E-18	NA	NA	NA	NA	NA	NA	9.72E-18
Acetonitrile	1.07E-13	2.15E-13	1.67E-19	6.50E-20	2.36E-17	1.40E-20	1.12E-17	3.22E-13
Acrylonitrile	2.45E-14	NA	NA	NA	NA	NA	NA	2.45E-14
Aldrin	4.46E-14	1.64E-12	1.73E-12	1.96E-13	4.99E-16	6.95E-18	2.38E-16	3.61E-12
Atrazine	4.96E-16	8.74E-17	7.30E-20	1.63E-20	2.24E-19	0.00E+00	1.07E-19	5.83E-16
Benzaldehyde	2.33E-12	9.39E-13	1.38E-16	5.05E-17	3.07E-15	2.31E-16	1.46E-15	3.28E-12
Benzene	7.05E-12	NA	NA	NA	NA	NA	NA	7.05E-12
Benzofuran	8.95E-11	3.93E-11	2.28E-14	6.80E-15	1.18E-13	3.99E-14	5.62E-14	1.29E-10
Benzoic Acid	2.82E-14	8.61E-15	2.59E-18	9.08E-19	3.71E-17	5.02E-18	1.77E-17	3.69E-14
Benzonitrile	1.34E-14	5.07E-15	8.67E-19	3.15E-19	1.77E-17	1.48E-18	8.42E-18	1.85E-14
Biphenyl	8.42E-11	NA	NA	NA	NA	NA	NA	8.42E-11
Bromomethane	1.31E-12	NA	NA	NA	NA	NA	NA	1.31E-12
Carbazole	4.30E-15	1.32E-15	2.85E-18	6.91E-19	5.65E-18	2.55E-18	2.70E-18	5.63E-15
Carbon Tetrachloride	2.26E-15	NA	NA	NA	NA	NA	NA	2.26E-15
Chlorobenzene	1.11E-11	NA	NA	NA	NA	NA	NA	1.11E-11
4-Chlorobiphenyl	5.30E-12	8.93E-13	8.41E-14	1.16E-14	6.97E-15	2.29E-15	3.34E-15	6.30E-12
4,4-Chlorobiphenyl	7.30E-14	1.01E-14	5.24E-15	6.45E-16	9.60E-17	1.05E-17	4.60E-17	8.91E-14
Chloroform	2.26E-16	NA	NA	NA	NA	NA	NA	2.26E-16
4-Chlorophenylmethylsulfone	2.10E-15	5.78E-16	5.22E-20	1.88E-20	1.49E-18	1.49E-19	7.09E-19	2.68E-15
4-Chlorophenylmethylsulfoxide	7.80E-15	2.26E-15	2.25E-19	7.99E-20	5.53E-18	5.49E-19	2.64E-18	1.01E-14
p,p-DDE	3.79E-11	1.68E-12	3.47E-12	4.20E-13	4.60E-14	1.27E-12	2.19E-14	4.48E-11
p,p-DDT	3.72E-15	2.17E-15	3.19E-15	3.69E-16	9.21E-18	2.66E-16	4.39E-18	9.73E-15
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	1.01E-15	NA	NA	NA	NA	NA	NA	1.01E-15
1,1-Dichloroethene	3.07E-15	NA	NA	NA	NA	NA	NA	3.07E-15
1,2-Dichloroethene	2.18E-15	NA	NA	NA	NA	NA	NA	2.18E-15
1,2-Dichloropropane	1.43E-17	NA	NA	NA	NA	NA	NA	1.43E-17
Dieldrin	9.16E-15	1.35E-12	1.37E-14	1.60E-15	6.15E-17	1.78E-16	2.93E-17	1.37E-12
Diisopropyl Methylphosphonate	5.13E-15	1.29E-15	3.02E-19	1.04E-19	4.85E-18	7.01E-19	2.31E-18	6.43E-15
1,3-Dimethylbenzene	2.24E-13	2.87E-13	5.11E-16	1.28E-16	1.18E-15	5.17E-16	5.62E-16	5.13E-13
Dimethyldisulfide	1.41E-13	NA	NA	NA	NA	NA	NA	1.41E-13
Dimethyl Methylphosphonate	5.43E-13	3.10E-13	2.82E-20	1.07E-20	1.70E-17	1.71E-17	8.11E-18	8.53E-13
Dimethylphosphate	3.08E-14	1.22E-15	NE	NE	4.05E-17	NE	1.93E-17	3.21E-14
Dioxins/Furans (EPA TEFs)	6.86E-06	3.55E-07	1.25E-06	5.11E-07	8.49E-09	2.24E-08	4.05E-09	9.01E-06
Dithiane	4.11E-17	3.35E-17	1.15E-21	4.40E-22	5.40E-20	1.49E-21	2.58E-20	7.47E-17
Endrin	2.23E-14	3.21E-16	5.73E-17	8.50E-18	9.27E-18	4.19E-18	4.42E-18	2.27E-14
Ethylbenzene	1.52E-13	NA	NA	NA	NA	NA	NA	1.52E-13
Hexachlorobenzene	9.54E-13	2.66E-13	5.32E-14	6.57E-15	1.12E-15	5.51E-15	5.33E-16	1.29E-12
Hexachlorocyclopentadiene	1.06E-12	9.19E-15	1.85E-16	2.30E-17	3.98E-18	9.93E-19	1.90E-18	1.07E-12
Isodrin	8.56E-14	1.25E-12	5.08E-14	5.86E-15	1.13E-16	2.92E-15	5.37E-17	1.40E-12
Malathion	8.96E-16	6.88E-17	1.60E-19	4.48E-20	6.02E-19	0.00E+00	2.87E-19	9.66E-16

Table 10-7
(continued)

Methanol	9.72E-13	2.98E-12	3.03E-18	1.18E-18	6.83E-16	1.90E-17	3.26E-16	3.96E-12
Methyl Chloride	2.13E-12	NA	NA	NA	NA	NA	NA	2.13E-12
Methylene Chloride	2.61E-14	NA	NA	NA	NA	NA	NA	2.61E-14
4-Nitrophenol	3.79E-14	1.42E-14	1.37E-17	3.80E-18	4.98E-17	1.96E-17	2.37E-17	5.22E-14
PAHs								
Acenaphthalene	1.87E-12	9.35E-13	5.20E-15	9.26E-16	2.46E-15	1.58E-15	1.17E-15	2.81E-12
Acenaphthene	1.87E-12	4.42E-13	3.88E-15	7.31E-16	2.46E-15	6.13E-16	1.17E-15	2.32E-12
Benzo(a)pyrene	7.45E-13	3.45E-14	3.58E-13	4.07E-14	4.80E-16	4.21E-16	2.29E-16	1.18E-12
Chrysene	7.45E-13	7.87E-14	8.48E-14	9.90E-15	5.45E-16	1.06E-14	2.60E-16	9.30E-13
Dibenzo(a,h)anthracene	7.45E-13	4.06E-14	4.30E-13	4.91E-14	5.68E-16	2.39E-13	2.71E-16	1.50E-12
Fluoranthene	1.68E-12	2.77E-13	5.24E-14	6.39E-15	1.21E-15	NA	5.78E-16	2.02E-12
Fluorene	5.59E-13	1.74E-13	2.93E-15	4.67E-16	7.35E-16	6.59E-16	3.51E-16	7.38E-13
Phenanthrene	1.49E-12	1.91E-13	1.08E-14	1.41E-15	8.78E-16	2.95E-15	4.19E-16	1.70E-12
Pyrene	7.45E-13	9.90E-14	2.11E-14	2.54E-15	4.30E-16	2.42E-15	2.05E-16	8.71E-13
Parathion	2.47E-14	5.15E-17	3.54E-19	6.97E-20	2.77E-19	1.09E-19	1.32E-19	2.48E-14
Pentachlorobenzene	4.27E-13	2.38E-13	1.01E-14	1.33E-15	5.62E-16	NA	2.68E-16	6.78E-13
Phenol	6.24E-11	5.17E-12	1.17E-16	4.28E-17	2.66E-15	3.50E-17	1.27E-15	6.76E-11
Pyridine	6.59E-16	NA	NA	NA	NA	NA	NA	6.59E-16
Quinoline	2.67E-16	2.06E-16	2.96E-20	1.02E-20	3.52E-19	6.11E-20	1.68E-19	4.74E-16
Styrene	1.03E-12	NA	NA	NA	NA	NA	NA	1.03E-12
Supona	2.53E-14	6.29E-15	1.25E-17	3.23E-18	3.32E-17	1.42E-17	1.59E-17	3.16E-14
Tetrachlorobenzene	4.80E-13	5.99E-13	2.46E-15	3.94E-16	6.32E-16	NA	3.01E-16	1.08E-12
Tetrachloroethene	2.58E-15	NA	NA	NA	NA	NA	NA	2.58E-15
Toluene	1.96E-13	NA	NA	NA	NA	NA	NA	1.96E-13
Trichlorobenzene	2.53E-14	5.73E-16	8.86E-18	1.63E-18	4.99E-18	4.78E-18	2.38E-18	2.59E-14
Trichloroethene	5.01E-16	NA	NA	NA	NA	NA	NA	5.01E-16
Urea	1.94E-11	1.79E-09	1.41E-17	5.51E-18	2.55E-14	7.09E-16	1.20E-14	1.81E-09
Vapona	1.26E-14	5.43E-15	6.84E-19	2.52E-19	1.66E-17	1.10E-18	7.92E-18	1.81E-14
Vinyl Chloride	1.68E-11	NA	NA	NA	NA	NA	NA	1.68E-11
Xylene	5.22E-13	NA	NA	NA	NA	NA	NA	5.22E-13
INORGANICS								
Aluminum	1.45E-05	NA	NA	NA	NA	NE	NA	1.45E-05
Ammonia	3.09E-07	NA	NA	NA	NA	NA	NA	3.09E-07
Antimony	2.04E-06	1.11E-07	6.07E-09	2.49E-09	3.43E-09	NA	1.63E-09	2.17E-06
Arsenic	2.89E-05	2.38E-07	9.12E-07	1.12E-08	7.76E-09	1.49E-08	3.70E-09	3.01E-05
Barium	1.44E-05	8.53E-10	1.74E-10	2.87E-12	2.72E-11	NE	1.29E-11	1.44E-05
Beryllium	2.96E-05	4.82E-10	2.44E-13	9.89E-12	1.59E-11	1.53E-12	7.57E-12	2.96E-05
Boron	1.07E-05	NA	NA	NA	NA	NE	NA	1.07E-05
Cadmium	3.37E-06	NA	NA	NA	NA	3.78E-10	NA	3.37E-06
Calcium	1.73E-04	NA	NA	NA	NA	NA	NA	1.73E-04
Chromium (III)	7.69E-07	NA	NA	NA	NA	NA	NA	7.69E-07
Chromium (VI)	2.71E-07	NA	NA	NA	NA	2.86E-12	NA	2.71E-07
Cobalt	2.55E-05	NA	NA	NA	NA	7.55E-11	NA	2.55E-05
Copper	5.53E-04	8.51E-06	6.79E-06	2.55E-06	1.92E-07	1.18E-06	9.13E-08	5.72E-04
Cyanogen	5.02E-16	NA	NA	NA	NA	NA	NA	5.02E-16
Hydrogen Cyanide	2.08E-11	NA	NA	NA	NA	NA	NA	2.08E-11
Iron	7.71E-05	NA	NA	NA	NA	NE	NA	7.71E-05
Lead	4.31E-06	5.36E-08	7.92E-09	3.81E-10	1.74E-09	1.63E-09	8.30E-10	4.37E-06
Lithium	1.81E-06	NA	NA	NA	NA	NE	NA	1.81E-06

Table 10-7
(continued)

Magnesium	3.82E-05	NA	NA	NA	NA	NE	NA	3.82E-05
Manganese	3.38E-05	NA	NA	NA	NA	NA	NA	3.38E-05
Mercury	1.90E-05	3.09E-07	7.16E-08	2.44E-06	7.16E-09	NA	3.41E-09	2.19E-05
Molybdenum	3.56E-06	NA	NA	NA	NA	NE	NA	3.56E-06
Nickel	4.62E-04	NA	NA	NA	NA	NA	NA	4.62E-04
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	7.42E-02	2.10E-04	5.26E-04	7.85E-05	6.64E-06	5.83E-07	3.16E-06	7.50E-02
Silicon	5.11E-03	NA	NA	NA	NA	NA	NA	5.11E-03
Silver	1.54E-02	2.51E-06	3.00E-05	2.21E-07	6.88E-08	1.15E-06	3.28E-08	1.54E-02
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	1.49E-04	8.66E-06	9.73E-06	7.07E-06	2.86E-07	NA	1.36E-07	1.75E-04
Tin	6.52E-06	NA	NA	NA	NA	NE	NA	6.52E-06
Titanium	1.65E-08	NA	NA	NA	NA	NE	NA	1.65E-08
Vanadium	7.55E-05	NA	NA	NA	NA	3.68E-11	NA	7.55E-05
Yittrium	3.45E-08	NA	NA	NA	NA	NE	NA	3.45E-08
Zinc	3.27E-06	NA	NA	NA	NA	5.30E-10	NA	3.27E-06
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	1.34E-04	NA	NA	NA	NA	NA	NA	1.34E-04
Hydrogen Chloride	1.02E-03	NA	NA	NA	NA	NA	NA	1.02E-03
Hydrogen Fluorides	1.04E-04	NA	NA	NA	NA	NA	NA	1.04E-04
Nitric Acid	1.21E-03	NA	NA	NA	NA	NA	NA	1.21E-03
Nitrogen Dioxide	1.85E-03	NA	NA	NA	NA	NA	NA	1.85E-03
Particulate Matter	5.33E-04	NA	NA	NA	NA	NA	NA	5.33E-04
Sulfur Dioxide	1.76E-03	NA	NA	NA	NA	NA	NA	1.76E-03
Sulfuric Acid Mist	1.66E-02	NA	NA	NA	NA	NA	NA	1.66E-02
Total (Hazard Index)	1.20E-01	2.30E-04	5.75E-04	9.13E-05	7.21E-06	2.95E-06	3.44E-06	1.20E-01

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Table 10-8

Adult Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposure for the Worker Scenario

Pollutant	Inhalation	Soil/Dust Ingestion	Dermal Absorption	Total
	Exposure Routes			
ORGANICS				
Acetone	2.79E-18	NA	NA	2.79E-18
Acetonitrile	3.08E-14	1.11E-17	1.72E-17	3.08E-14
Acrylonitrile	7.02E-15	NA	NA	7.02E-15
Aldrin	1.28E-14	2.35E-16	3.64E-16	1.34E-14
Atrazine	1.42E-16	1.05E-19	1.63E-19	1.42E-16
Benzaldehyde	6.69E-13	1.45E-15	2.24E-15	6.72E-13
Benzene	2.02E-12	NA	NA	2.02E-12
Benzofuran	2.57E-11	5.55E-14	8.59E-14	2.58E-11
Benzoic Acid	8.10E-15	1.75E-17	2.71E-17	8.14E-15
Benzonitrile	3.85E-15	8.33E-18	1.29E-17	3.87E-15
Biphenyl	2.42E-11	NA	NA	2.42E-11
Bromomethane	3.76E-13	NA	NA	3.76E-13
Carbazole	1.23E-15	2.67E-18	4.12E-18	1.24E-15
Carbon Tetrachloride	6.47E-16	NA	NA	6.47E-16
Chlorobenzene	3.17E-12	NA	NA	3.17E-12
4-Chlorobiphenyl	1.52E-12	3.29E-15	5.11E-15	1.53E-12
4,4-Chlorobiphenyl	2.09E-14	4.53E-17	7.04E-17	2.10E-14
Chloroform	6.48E-17	NA	NA	6.48E-17
4-Chlorophenylmethylsulfone	6.01E-16	7.01E-19	1.08E-18	6.03E-16
4-Chlorophenylmethylsulfoxide	2.24E-15	2.61E-18	4.03E-18	2.24E-15
p,p-DDE	1.09E-11	2.17E-14	3.35E-14	1.09E-11
p,p-DDT	1.07E-15	4.34E-18	6.72E-18	1.08E-15
Dibenzofuran	NE	NE	NE	NE
Dichlorobenzenes (total)	2.89E-16	NA	NA	2.89E-16
1,1-Dichloroethene	8.81E-16	NA	NA	8.81E-16
1,2-Dichloroethene	6.25E-16	NA	NA	6.25E-16
1,2-Dichloropropane	4.11E-18	NA	NA	4.11E-18
Dieldrin	2.63E-15	2.90E-17	4.48E-17	2.70E-15
Diisopropyl Methylphosphonate	1.47E-15	2.29E-18	3.54E-18	1.48E-15
1,3-Dimethylbenzene	6.42E-14	5.55E-16	8.59E-16	6.56E-14
Dimethyldisulfide	4.03E-14	NA	NA	4.03E-14
Dimethyl Methylphosphonate	1.56E-13	8.01E-18	1.24E-17	1.56E-13
Dimethylphosphate	8.84E-15	1.91E-17	2.95E-17	8.89E-15
Dioxins/Furans (EPA TEFs)	1.97E-06	4.00E-09	6.19E-09	1.98E-06
Dithiane	1.18E-17	2.55E-20	3.94E-20	1.18E-17
Endrin	6.39E-15	4.37E-18	6.76E-18	6.40E-15
Ethylbenzene	4.35E-14	NA	NA	4.35E-14
Hexachlorobenzene	2.74E-13	5.27E-16	8.15E-16	2.75E-13
Hexachlorocyclopentadiene	3.04E-13	1.88E-18	2.90E-18	3.04E-13
Isodrin	2.45E-14	5.31E-17	8.21E-17	2.47E-14
Malathion	2.57E-16	2.84E-19	4.39E-19	2.58E-16
Methanol	2.79E-13	3.22E-16	4.98E-16	2.80E-13
Methyl Chloride	6.12E-13	NA	NA	6.12E-13
Methylene Chloride	7.50E-15	NA	NA	7.50E-15
4-Nitrophenol	1.09E-14	2.35E-17	3.63E-17	1.09E-14
PAHs				
Acenaphthalene	5.35E-13	1.16E-15	1.79E-15	5.38E-13
Acenaphthene	5.35E-13	1.16E-15	1.79E-15	5.38E-13
Benzo(a)pyrene	2.14E-13	2.26E-16	3.50E-16	2.14E-13
Chrysene	2.14E-13	2.57E-16	3.97E-16	2.14E-13
Dibenzo(a,h)anthracene	2.14E-13	2.68E-16	4.14E-16	2.14E-13
Fluoranthene	4.82E-13	5.71E-16	8.83E-16	4.83E-13
Fluorene	1.60E-13	3.47E-16	5.36E-16	1.61E-13
Phenanthrene	4.28E-13	4.14E-16	6.41E-16	4.29E-13
Pyrene	2.14E-13	2.03E-16	3.14E-16	2.14E-13
Parathion	7.10E-15	1.30E-19	2.02E-19	7.10E-15
Pentachlorobenzene	1.22E-13	2.65E-16	4.10E-16	1.23E-13
Phenol	1.79E-11	1.25E-15	1.94E-15	1.79E-11
Pyridine	1.89E-16	NA	NA	1.89E-16
Quinoline	7.67E-17	1.66E-19	2.57E-19	7.71E-17
Styrene	2.97E-13	NA	NA	2.97E-13
Supona	7.25E-15	1.57E-17	2.43E-17	7.29E-15

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Table 10-8
(continued)

Tetrachlorobenzene	1.38E-13	2.98E-16	4.61E-16	1.38E-13
Tetrachloroethene	7.39E-16	NA	NA	7.39E-16
Toluene	5.63E-14	NA	NA	5.63E-14
Trichlorobenzene	7.26E-15	2.35E-18	3.64E-18	7.26E-15
Trichloroethene	1.44E-16	NA	NA	1.44E-16
Urea	5.56E-12	1.20E-14	1.84E-14	5.59E-12
Vapona	3.62E-15	7.84E-18	1.21E-17	3.64E-15
Vinyl Chloride	4.83E-12	NA	NA	4.83E-12
Xylene	1.50E-13	NA	NA	1.50E-13
INORGANICS				
Aluminum	4.17E-06	NA	NA	4.17E-06
Ammonia	8.87E-08	NA	NA	8.87E-08
Antimony	5.86E-07	1.62E-09	2.50E-09	5.90E-07
Arsenic	8.29E-06	3.66E-09	5.66E-09	8.30E-06
Barium	4.14E-06	1.28E-11	1.98E-11	4.14E-06
Beryllium	8.48E-06	7.49E-12	1.16E-11	8.48E-06
Boron	3.07E-06	NA	NA	3.07E-06
Cadmium	9.67E-07	NA	NA	9.67E-07
Calcium	4.97E-05	NA	NA	4.97E-05
Chromium (III)	2.21E-07	NA	NA	2.21E-07
Chromium (VI)	7.76E-08	NA	NA	7.76E-08
Cobalt	7.30E-06	NA	NA	7.30E-06
Copper	1.59E-04	9.03E-08	1.40E-07	1.59E-04
Cyanogen	1.44E-16	NA	NA	1.44E-16
Hydrogen Cyanide	5.96E-12	NA	NA	5.96E-12
Iron	2.21E-05	NA	NA	2.21E-05
Lead	1.23E-06	8.21E-10	1.27E-09	1.24E-06
Lithium	5.19E-07	NA	NA	5.19E-07
Magnesium	1.10E-05	NA	NA	1.10E-05
Manganese	9.70E-06	NA	NA	9.70E-06
Mercury	5.46E-06	3.38E-09	5.22E-09	5.47E-06
Molybdenum	1.02E-06	NA	NA	1.02E-06
Nickel	1.32E-04	NA	NA	1.32E-04
Phosphate	NE	NA	NA	NE
Potassium	NE	NA	NA	NE
Selenium	2.13E-02	3.13E-06	4.84E-06	2.13E-02
Silicon	1.47E-03	NA	NA	1.47E-03
Silver	4.41E-03	3.24E-08	5.02E-08	4.41E-03
Sodium	NE	NA	NA	NE
Strontium	NE	NA	NA	NE
Thallium	4.28E-05	1.35E-07	2.09E-07	4.31E-05
Tin	1.87E-06	NA	NA	1.87E-06
Titanium	4.72E-09	NA	NA	4.72E-09
Vanadium	2.16E-05	NA	NA	2.16E-05
Yittrium	9.90E-09	NA	NA	9.90E-09
Zinc	9.38E-07	NA	NA	9.38E-07
CRITERIA POLLUTANTS/ ACID GASES				
Carbon Monoxide	3.84E-05	NA	NA	3.84E-05
Hydrogen Chloride	2.91E-04	NA	NA	2.91E-04
Hydrogen Fluorides	2.97E-05	NA	NA	2.97E-05
Nitric Acid	3.46E-04	NA	NA	3.46E-04
Nitrogen Dioxide	5.32E-04	NA	NA	5.32E-04
Particulate Matter	1.53E-04	NA	NA	1.53E-04
Sulfur Dioxide	5.04E-04	NA	NA	5.04E-04
Sulfuric Acid Mist	4.76E-03	NA	NA	4.76E-03
Total (Hazard Index)	3.43E-02	3.40E-06	5.26E-06	3.43E-02

Table 10-9

Child Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposure for the Resident-A Scenario

Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
	Exposure Routes							
ORGANICS								
Acetone	6.26E-17	NA	NA	NA	NA	NA	NA	6.26E-17
Acetonitrile	6.91E-13	8.57E-14	4.81E-20	8.10E-21	2.48E-16	3.17E-20	2.22E-17	7.77E-13
Acrylonitrile	1.57E-13	NA	NA	NA	NA	NA	NA	1.57E-13
Aldrin	2.87E-13	3.79E-13	5.01E-13	2.45E-14	5.26E-15	1.57E-17	4.70E-16	1.20E-12
Atrazine	3.19E-15	8.99E-17	2.11E-20	2.04E-21	2.36E-18	0.00E+00	2.11E-19	3.28E-15
Benzaldehyde	1.50E-11	9.50E-13	3.98E-17	6.29E-18	3.23E-14	5.21E-16	2.89E-15	1.60E-11
Benzene	4.54E-11	NA	NA	NA	NA	NA	NA	4.54E-11
Benzofuran	5.76E-10	2.31E-11	6.57E-15	8.48E-16	1.24E-12	9.00E-14	1.11E-13	6.01E-10
Benzoic Acid	1.82E-13	8.70E-15	7.47E-19	1.13E-19	3.91E-16	1.13E-17	3.50E-17	1.91E-13
Benzonitrile	8.64E-14	5.14E-15	2.50E-19	3.93E-20	1.86E-16	3.34E-18	1.66E-17	9.18E-14
Biphenyl	5.42E-10	NA	NA	NA	NA	NA	NA	5.42E-10
Bromomethane	8.43E-12	NA	NA	NA	NA	NA	NA	8.43E-12
Carbazole	2.77E-14	8.98E-16	8.22E-19	8.61E-20	5.96E-17	5.75E-18	5.33E-18	2.86E-14
Carbon Tetrachloride	1.45E-14	NA	NA	NA	NA	NA	NA	1.45E-14
Chlorobenzene	7.12E-11	NA	NA	NA	NA	NA	NA	7.12E-11
4-Chlorobiphenyl	3.41E-11	8.78E-13	2.43E-14	1.45E-15	7.35E-14	5.16E-15	6.60E-15	3.51E-11
4,4-Chlorobiphenyl	4.70E-13	1.16E-14	1.51E-15	8.04E-17	1.01E-15	2.37E-17	9.09E-17	4.84E-13
Chloroform	1.45E-15	NA	NA	NA	NA	NA	NA	1.45E-15
4-Chlorophenylmethylsulfone	1.35E-14	7.11E-16	1.51E-20	2.34E-21	1.57E-17	3.36E-19	1.40E-18	1.42E-14
4-Chlorophenylmethylsulfoxide	5.02E-14	2.48E-15	6.50E-20	9.96E-21	5.83E-17	1.24E-18	5.21E-18	5.28E-14
p,p-DDE	2.44E-10	5.27E-12	1.00E-12	5.24E-14	4.85E-13	2.87E-12	4.33E-14	2.53E-10
p,p-DDT	2.39E-14	1.42E-15	9.22E-16	4.61E-17	9.71E-17	6.00E-16	8.68E-18	2.70E-14
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	6.48E-15	NA	NA	NA	NA	NA	NA	6.48E-15
1,1-Dichloroethene	1.98E-14	NA	NA	NA	NA	NA	NA	1.98E-14
1,2-Dichloroethene	1.40E-14	NA	NA	NA	NA	NA	NA	1.40E-14
1,2-Dichloropropane	9.22E-17	NA	NA	NA	NA	NA	NA	9.22E-17
Dieldrin	5.90E-14	2.78E-13	3.95E-15	1.99E-16	6.48E-16	4.02E-16	5.79E-17	3.42E-13
Diisopropyl Methylphosphonate	3.30E-14	1.44E-15	8.71E-20	1.30E-20	5.11E-17	1.58E-18	4.57E-18	3.45E-14
1,3-Dimethylbenzene	1.44E-12	1.92E-13	1.47E-16	1.60E-17	1.24E-14	1.17E-15	1.11E-15	1.65E-12
Dimethyldisulfide	9.04E-13	NA	NA	NA	NA	NA	NA	9.04E-13
Dimethyl Methylphosphonate	3.50E-12	3.59E-13	8.14E-21	1.33E-21	1.79E-16	3.85E-17	1.60E-17	3.86E-12
Dimethylphosphate	1.98E-13	4.24E-15	NE	NE	4.27E-16	NE	3.82E-17	2.03E-13
Dioxins/Furans (EPA TEFs)	4.41E-05	9.63E-07	4.11E-07	6.93E-08	8.95E-08	5.06E-08	8.00E-09	4.57E-05
Dithiane	2.64E-16	3.29E-17	3.33E-22	5.48E-23	5.69E-19	3.36E-21	5.09E-20	2.98E-16
Endrin	1.43E-13	1.07E-15	1.65E-17	1.06E-18	9.77E-17	9.47E-18	8.74E-18	1.45E-13
Ethylbenzene	9.76E-13	NA	NA	NA	NA	NA	NA	9.76E-13
Hexachlorobenzene	6.14E-12	1.78E-13	1.54E-14	8.19E-16	1.18E-14	1.24E-14	1.05E-15	6.36E-12
Hexachlorocyclopentadiene	6.81E-12	2.25E-15	5.36E-17	2.87E-18	4.19E-17	2.24E-18	3.75E-18	6.81E-12
Isodrin	5.51E-13	2.64E-13	1.47E-14	7.31E-16	1.19E-15	6.59E-15	1.06E-16	8.38E-13
Malathion	5.77E-15	8.68E-17	4.63E-20	5.59E-21	6.34E-18	0.00E+00	5.67E-19	5.86E-15

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Table 10-9
(continued)

Methanol	6.26E-12	2.87E-12	8.74E-19	1.48E-19	7.20E-15	4.29E-17	6.44E-16	9.14E-12
Methyl Chloride	1.37E-11	NA	NA	NA	NA	NA	NA	1.37E-11
Methylene Chloride	1.68E-13	NA	NA	NA	NA	NA	NA	1.68E-13
4-Nitrophenol	2.44E-13	8.88E-15	3.95E-18	4.74E-19	5.25E-16	4.42E-17	4.69E-17	2.53E-13
PAHs								
Acenaphthalene	1.20E-11	4.42E-13	1.50E-15	1.16E-16	2.59E-14	3.57E-15	2.31E-15	1.25E-11
Acenaphthene	1.20E-11	3.45E-13	1.12E-15	9.12E-17	2.59E-14	1.39E-15	2.31E-15	1.24E-11
Benzo(a)pyrene	4.80E-12	1.04E-13	1.03E-13	5.08E-15	5.06E-15	9.50E-16	4.53E-16	5.01E-12
Chrysene	4.80E-12	1.13E-13	2.45E-14	1.23E-15	5.74E-15	2.40E-14	5.13E-16	4.96E-12
Dibenzo(a,h)anthracene	4.80E-12	1.05E-13	1.24E-13	6.12E-15	5.98E-15	5.39E-13	5.35E-16	5.58E-12
Fluoranthene	1.08E-11	2.75E-13	1.51E-14	7.97E-16	1.28E-14	NA	1.14E-15	1.11E-11
Fluorene	3.60E-12	1.10E-13	8.45E-16	5.82E-17	7.75E-15	1.49E-15	6.93E-16	3.72E-12
Phenanthrene	9.60E-12	2.34E-13	3.11E-15	1.75E-16	9.25E-15	6.67E-15	8.27E-16	9.85E-12
Pyrene	4.80E-12	1.17E-13	6.09E-15	3.17E-16	4.53E-15	5.47E-15	4.05E-16	4.93E-12
Parathion	1.59E-13	3.95E-17	1.02E-19	8.69E-21	2.92E-18	2.46E-19	2.61E-19	1.59E-13
Pentachlorobenzene	2.75E-12	1.04E-13	2.90E-15	1.66E-16	5.92E-15	NA	5.29E-16	2.86E-12
Phenol	4.02E-10	1.71E-12	3.37E-17	5.34E-18	2.80E-14	7.91E-17	2.50E-15	4.04E-10
Pyridine	4.24E-15	NA	NA	NA	NA	NA	NA	4.24E-15
Quinoline	1.72E-15	1.01E-16	8.55E-21	1.27E-21	3.71E-18	1.38E-19	3.32E-19	1.83E-15
Styrene	6.66E-12	NA	NA	NA	NA	NA	NA	6.66E-12
Supona	1.63E-13	5.11E-15	3.60E-18	4.03E-19	3.50E-16	3.20E-17	3.13E-17	1.68E-13
Tetrachlorobenzene	3.09E-12	1.85E-13	7.11E-16	4.91E-17	6.66E-15	NA	5.95E-16	3.28E-12
Tetrachloroethene	1.66E-14	NA	NA	NA	NA	NA	NA	1.66E-14
Toluene	1.26E-12	NA	NA	NA	NA	NA	NA	1.26E-12
Trichlorobenzene	1.63E-13	6.34E-16	2.56E-18	2.04E-19	5.26E-17	1.08E-17	4.70E-18	1.63E-13
Trichloroethene	3.22E-15	NA	NA	NA	NA	NA	NA	3.22E-15
Urea	1.25E-10	1.82E-09	4.06E-18	6.87E-19	2.69E-13	1.60E-15	2.38E-14	1.94E-09
Vapona	8.13E-14	5.50E-15	1.98E-19	3.15E-20	1.75E-16	2.49E-18	1.57E-17	8.70E-14
Vinyl Chloride	1.08E-10	NA	NA	NA	NA	NA	NA	1.08E-10
Xylene	3.36E-12	NA	NA	NA	NA	NA	NA	3.36E-12
INORGANICS								
Aluminum	9.36E-05	NA	NA	NA	NA	NE	NA	9.36E-05
Ammonia	1.99E-06	NA	NA	NA	NA	NA	NA	1.99E-06
Antimony	1.32E-05	3.63E-07	1.75E-09	3.10E-10	3.61E-08	NA	3.23E-09	1.36E-05
Arsenic	1.86E-04	8.14E-07	2.63E-07	1.39E-09	8.18E-08	3.37E-08	7.31E-09	1.87E-04
Barium	9.30E-05	2.86E-09	5.02E-11	3.58E-13	2.86E-10	NE	2.56E-11	9.30E-05
Beryllium	1.90E-04	1.66E-09	7.04E-14	1.23E-12	1.67E-10	3.46E-12	1.50E-11	1.90E-04
Boron	6.89E-05	NA	NA	NA	NA	NE	NA	6.89E-05
Cadmium	2.17E-05	NA	NA	NA	NA	8.53E-10	NA	2.17E-05
Calcium	1.11E-03	NA	NA	NA	NA	NA	NA	1.11E-03
Chromium (III)	4.95E-06	NA	NA	NA	NA	NA	NA	4.95E-06
Chromium (VI)	1.74E-06	NA	NA	NA	NA	6.47E-12	NA	1.74E-06
Cobalt	1.64E-04	NA	NA	NA	NA	1.71E-10	NA	1.64E-04
Copper	3.56E-03	2.19E-05	1.96E-06	3.18E-07	2.02E-06	2.66E-06	1.80E-07	3.59E-03
Cyanogen	3.23E-15	NA	NA	NA	NA	NA	NA	3.23E-15
Hydrogen Cyanide	1.34E-10	NA	NA	NA	NA	NA	NA	1.34E-10
Iron	4.96E-04	NA	NA	NA	NA	NE	NA	4.96E-04
Lead	2.77E-05	1.83E-07	2.29E-09	4.74E-11	1.83E-08	3.68E-09	1.64E-09	2.79E-05
Lithium	1.17E-05	NA	NA	NA	NA	NE	NA	1.17E-05

Table 10-9
(continued)

Magnesium	2.46E-04	NA	NA	NA	NA	NE	NA	2.46E-04
Manganese	2.18E-04	NA	NA	NA	NA	NA	NA	2.18E-04
Mercury	1.23E-04	8.10E-07	2.07E-08	3.05E-07	7.54E-08	NA	6.74E-09	1.24E-04
Molybdenum	2.29E-05	NA	NA	NA	NA	NE	NA	2.29E-05
Nickel	2.97E-03	NA	NA	NA	NA	NA	NA	2.97E-03
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	4.77E-01	7.01E-04	1.52E-04	9.79E-06	6.99E-05	1.32E-06	6.25E-06	4.78E-01
Silicon	3.29E-02	NA	NA	NA	NA	NA	NA	3.29E-02
Silver	9.89E-02	7.48E-06	8.67E-06	2.76E-08	7.25E-07	2.60E-06	6.48E-08	9.89E-02
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	9.60E-04	3.00E-05	2.81E-06	8.81E-07	3.02E-06	NA	2.70E-07	9.97E-04
Tin	4.20E-05	NA	NA	NA	NA	NE	NA	4.20E-05
Titanium	1.06E-07	NA	NA	NA	NA	NE	NA	1.06E-07
Vanadium	4.86E-04	NA	NA	NA	NA	8.31E-11	NA	4.86E-04
Yittrium	2.22E-07	NA	NA	NA	NA	NE	NA	2.22E-07
Zinc	2.10E-05	NA	NA	NA	NA	1.20E-09	NA	2.11E-05
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	8.61E-04	NA	NA	NA	NA	NA	NA	8.61E-04
Hydrogen Chloride	6.54E-03	NA	NA	NA	NA	NA	NA	6.54E-03
Hydrogen Fluorides	6.66E-04	NA	NA	NA	NA	NA	NA	6.66E-04
Nitric Acid	7.77E-03	NA	NA	NA	NA	NA	NA	7.77E-03
Nitrogen Dioxide	1.19E-02	NA	NA	NA	NA	NA	NA	1.19E-02
Particulate Matter	3.43E-03	NA	NA	NA	NA	NA	NA	3.43E-03
Sulfur Dioxide	1.13E-02	NA	NA	NA	NA	NA	NA	1.13E-02
Sulfuric Acid Mist	1.07E-01	NA	NA	NA	NA	NA	NA	1.07E-01
Total (Hazard Index)	7.70E-01	7.64E-04	1.66E-04	1.14E-05	7.60E-05	6.67E-06	6.80E-06	7.71E-01

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Table 10-10

Child Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposure for the Resident-B Scenario

Pollutant	Exposure Routes							
	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
ORGANICS								
Acetone	9.80E-18	NA	NA	NA	NA	NA	NA	9.80E-18
Acetonitrile	1.08E-13	1.21E-13	4.81E-20	8.10E-21	3.59E-16	3.17E-20	3.21E-17	2.29E-13
Acrylonitrile	2.47E-14	NA	NA	NA	NA	NA	NA	2.47E-14
Aldrin	4.50E-14	4.80E-13	5.01E-13	2.45E-14	7.61E-15	1.57E-17	6.80E-16	1.06E-12
Atrazine	4.99E-16	3.91E-17	2.11E-20	2.04E-21	3.41E-18	0.00E+00	3.05E-19	5.42E-16
Benzaldehyde	2.35E-12	9.55E-13	3.98E-17	6.29E-18	4.67E-14	5.21E-16	4.18E-15	3.36E-12
Benzene	7.11E-12	NA	NA	NA	NA	NA	NA	7.11E-12
Benzofuran	9.02E-11	1.73E-11	6.57E-15	8.48E-16	1.79E-12	9.00E-14	1.60E-13	1.10E-10
Benzoic Acid	2.84E-14	7.50E-15	7.47E-19	1.13E-19	5.66E-16	1.13E-17	5.06E-17	3.66E-14
Benzonitrile	1.35E-14	5.01E-15	2.50E-19	3.93E-20	2.69E-16	3.34E-18	2.41E-17	1.88E-14
Biphenyl	8.49E-11	NA	NA	NA	NA	NA	NA	8.49E-11
Bromomethane	1.32E-12	NA	NA	NA	NA	NA	NA	1.32E-12
Carbazole	4.33E-15	5.26E-16	8.22E-19	8.61E-20	8.61E-17	5.75E-18	7.70E-18	4.96E-15
Carbon Tetrachloride	2.27E-15	NA	NA	NA	NA	NA	NA	2.27E-15
Chlorobenzene	1.11E-11	NA	NA	NA	NA	NA	NA	1.11E-11
4-Chlorobiphenyl	5.34E-12	3.17E-13	2.43E-14	1.45E-15	1.06E-13	5.16E-15	9.54E-15	5.80E-12
4,4-Chlorobiphenyl	7.35E-14	3.59E-15	1.51E-15	8.04E-17	1.46E-15	2.37E-17	1.31E-16	8.03E-14
Chloroform	2.28E-16	NA	NA	NA	NA	NA	NA	2.28E-16
4-Chlorophenylmethylsulfone	2.11E-15	6.51E-16	1.51E-20	2.34E-21	2.26E-17	3.36E-19	2.02E-18	2.79E-15
4-Chlorophenylmethylsulfoxide	7.86E-15	2.18E-15	6.50E-20	9.96E-21	8.43E-17	1.24E-18	7.53E-18	1.01E-14
p,p-DDE	3.81E-11	8.17E-13	1.00E-12	5.24E-14	7.01E-13	2.87E-12	6.27E-14	4.37E-11
p,p-DDT	3.74E-15	6.95E-16	9.22E-16	4.61E-17	1.40E-16	6.00E-16	1.25E-17	6.16E-15
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	1.01E-15	NA	NA	NA	NA	NA	NA	1.01E-15
1,1-Dichloroethene	3.09E-15	NA	NA	NA	NA	NA	NA	3.09E-15
1,2-Dichloroethene	2.19E-15	NA	NA	NA	NA	NA	NA	2.19E-15
1,2-Dichloropropane	1.44E-17	NA	NA	NA	NA	NA	NA	1.44E-17
Dieldrin	9.23E-15	3.93E-13	3.95E-15	1.99E-16	9.37E-16	4.02E-16	8.37E-17	4.08E-13
Diisopropyl Methylphosphonate	5.17E-15	1.17E-15	8.71E-20	1.30E-20	7.39E-17	1.58E-18	6.61E-18	6.42E-15
1,3-Dimethylbenzene	2.25E-13	1.16E-13	1.47E-16	1.60E-17	1.79E-14	1.17E-15	1.60E-15	3.62E-13
Dimethyldisulfide	1.42E-13	NA	NA	NA	NA	NA	NA	1.42E-13
Dimethyl Methylphosphonate	5.48E-13	4.21E-13	8.14E-21	1.33E-21	2.59E-16	3.85E-17	2.32E-17	9.69E-13
Dimethylphosphate	3.10E-14	5.94E-16	NE	NE	6.18E-16	NE	5.52E-17	3.23E-14
Dioxins/Furans (EPA TEFs)	6.91E-06	1.60E-07	4.11E-07	6.93E-08	1.29E-07	5.06E-08	1.16E-08	7.74E-06
Dithiane	4.14E-17	4.02E-17	3.33E-22	5.48E-23	8.23E-19	3.36E-21	7.36E-20	8.25E-17
Endrin	2.24E-14	1.85E-16	1.65E-17	1.06E-18	1.41E-16	9.47E-18	1.26E-17	2.28E-14
Ethylbenzene	1.53E-13	NA	NA	NA	NA	NA	NA	1.53E-13
Hexachlorobenzene	9.62E-13	8.62E-14	1.54E-14	8.19E-16	1.70E-14	1.24E-14	1.52E-15	1.09E-12
Hexachlorocyclopentadiene	1.07E-12	2.71E-15	5.36E-17	2.87E-18	6.06E-17	2.24E-18	5.42E-18	1.07E-12
Isodrin	8.62E-14	3.66E-13	1.47E-14	7.31E-16	1.71E-15	6.59E-15	1.53E-16	4.76E-13
Malathion	9.03E-16	4.33E-17	4.63E-20	5.59E-21	9.16E-18	0.00E+00	8.19E-19	9.57E-16

Table 10-10
(continued)

Methanol	9.80E-13	4.06E-12	8.74E-19	1.48E-19	1.04E-14	4.29E-17	9.31E-16	5.05E-12
Methyl Chloride	2.15E-12	NA	NA	NA	NA	NA	NA	2.15E-12
Methylene Chloride	2.63E-14	NA	NA	NA	NA	NA	NA	2.63E-14
4-Nitrophenol	3.81E-14	6.03E-15	3.95E-18	4.74E-19	7.59E-16	4.42E-17	6.78E-17	4.50E-14
PAHs								
Acenaphthalene	1.88E-12	3.04E-13	1.50E-15	1.16E-16	3.74E-14	3.57E-15	3.35E-15	2.23E-12
Acenaphthene	1.88E-12	1.64E-13	1.12E-15	9.12E-17	3.74E-14	1.39E-15	3.35E-15	2.09E-12
Benzo(a)pyrene	7.51E-13	1.59E-14	1.03E-13	5.08E-15	7.31E-15	9.50E-16	6.54E-16	8.84E-13
Chrysene	7.51E-13	2.91E-14	2.45E-14	1.23E-15	8.30E-15	2.40E-14	7.42E-16	8.39E-13
Dibenzo(a,h)anthracene	7.51E-13	1.77E-14	1.24E-13	6.12E-15	8.64E-15	5.39E-13	7.73E-16	1.45E-12
Fluoranthene	1.69E-12	9.54E-14	1.51E-14	7.97E-16	1.85E-14	NA	1.65E-15	1.82E-12
Fluorene	5.63E-13	5.84E-14	8.45E-16	5.82E-17	1.12E-14	1.49E-15	1.00E-15	6.36E-13
Phenanthrene	1.50E-12	7.04E-14	3.11E-15	1.75E-16	1.34E-14	6.67E-15	1.20E-15	1.60E-12
Pyrene	7.51E-13	3.53E-14	6.09E-15	3.17E-16	6.55E-15	5.47E-15	5.85E-16	8.05E-13
Parathion	2.49E-14	1.93E-17	1.02E-19	8.69E-21	4.22E-18	2.46E-19	3.77E-19	2.50E-14
Pentachlorobenzene	4.30E-13	7.38E-14	2.90E-15	1.66E-16	8.56E-15	NA	7.65E-16	5.16E-13
Phenol	6.29E-11	2.11E-12	3.37E-17	5.34E-18	4.05E-14	7.91E-17	3.62E-15	6.51E-11
Pyridine	6.64E-16	NA	NA	NA	NA	NA	NA	6.64E-16
Quinoline	2.69E-16	9.87E-17	8.55E-21	1.27E-21	5.36E-18	1.38E-19	4.79E-19	3.74E-16
Styrene	1.04E-12	NA	NA	NA	NA	NA	NA	1.04E-12
Supona	2.55E-14	2.84E-15	3.60E-18	4.03E-19	5.06E-16	3.20E-17	4.53E-17	2.89E-14
Tetrachlorobenzene	4.84E-13	1.81E-13	7.11E-16	4.91E-17	9.62E-15	NA	8.60E-16	6.76E-13
Tetrachloroethene	2.60E-15	NA	NA	NA	NA	NA	NA	2.60E-15
Toluene	1.98E-13	NA	NA	NA	NA	NA	NA	1.98E-13
Trichlorobenzene	2.55E-14	2.34E-16	2.56E-18	2.04E-19	7.61E-17	1.08E-17	6.80E-18	2.58E-14
Trichloroethene	5.04E-16	NA	NA	NA	NA	NA	NA	5.04E-16
Urea	1.95E-11	2.62E-09	4.06E-18	6.87E-19	3.88E-13	1.60E-15	3.44E-14	2.64E-09
Vapona	1.27E-14	5.68E-15	1.98E-19	3.15E-20	2.53E-16	2.49E-18	2.26E-17	1.87E-14
Vinyl Chloride	1.70E-11	NA	NA	NA	NA	NA	NA	1.70E-11
Xylene	5.26E-13	NA	NA	NA	NA	NA	NA	5.26E-13
INORGANICS								
Aluminum	1.47E-05	NA	NA	NA	NA	NE	NA	1.47E-05
Ammonia	3.12E-07	NA	NA	NA	NA	NA	NA	3.12E-07
Antimony	2.06E-06	5.69E-08	1.75E-09	3.10E-10	5.22E-08	NA	4.67E-09	2.18E-06
Arsenic	2.91E-05	1.17E-07	2.63E-07	1.39E-09	1.18E-07	3.37E-08	1.06E-08	2.97E-05
Barium	1.46E-05	4.26E-10	5.02E-11	3.58E-13	4.14E-10	NE	3.70E-11	1.46E-05
Beryllium	2.98E-05	2.34E-10	7.04E-14	1.23E-12	2.42E-10	3.46E-12	2.16E-11	2.98E-05
Boron	1.08E-05	NA	NA	NA	NA	NE	NA	1.08E-05
Cadmium	3.40E-06	NA	NA	NA	NA	8.53E-10	NA	3.40E-06
Calcium	1.74E-04	NA	NA	NA	NA	NA	NA	1.74E-04
Chromium (III)	7.75E-07	NA	NA	NA	NA	NA	NA	7.75E-07
Chromium (VI)	2.73E-07	NA	NA	NA	NA	6.47E-12	NA	2.73E-07
Cobalt	2.57E-05	NA	NA	NA	NA	1.71E-10	NA	2.57E-05
Copper	5.57E-04	5.54E-06	1.96E-06	3.18E-07	2.92E-06	2.66E-06	2.61E-07	5.71E-04
Cyanogen	5.06E-16	NA	NA	NA	NA	NA	NA	5.06E-16
Hydrogen Cyanide	2.10E-11	NA	NA	NA	NA	NA	NA	2.10E-11
Iron	7.77E-05	NA	NA	NA	NA	NE	NA	7.77E-05
Lead	4.34E-06	2.65E-08	2.29E-09	4.74E-11	2.65E-08	3.68E-09	2.37E-09	4.40E-06
Lithium	1.82E-06	NA	NA	NA	NA	NE	NA	1.82E-06

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Table 10-10
(continued)

Magnesium	3.85E-05	NA	NA	NA	NA	NE	NA	3.85E-05
Manganese	3.41E-05	NA	NA	NA	NA	NA	NA	3.41E-05
Mercury	1.92E-05	1.92E-07	2.07E-08	3.05E-07	1.09E-07	NA	9.75E-09	1.98E-05
Molybdenum	3.59E-06	NA	NA	NA	NA	NE	NA	3.59E-06
Nickel	4.65E-04	NA	NA	NA	NA	NA	NA	4.65E-04
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	7.47E-02	1.07E-04	1.52E-04	9.79E-06	1.01E-04	1.32E-06	9.04E-06	7.51E-02
Silicon	5.15E-03	NA	NA	NA	NA	NA	NA	5.15E-03
Silver	1.55E-02	1.42E-06	8.67E-06	2.76E-08	1.05E-06	2.60E-06	9.37E-08	1.55E-02
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	1.50E-04	4.20E-06	2.81E-06	8.81E-07	4.36E-06	NA	3.90E-07	1.63E-04
Tin	6.57E-06	NA	NA	NA	NA	NE	NA	6.57E-06
Titanium	1.66E-08	NA	NA	NA	NA	NE	NA	1.66E-08
Vanadium	7.61E-05	NA	NA	NA	NA	8.31E-11	NA	7.61E-05
Yittrium	3.48E-08	NA	NA	NA	NA	NE	NA	3.48E-08
Zinc	3.30E-06	NA	NA	NA	NA	1.20E-09	NA	3.30E-06
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	1.35E-04	NA	NA	NA	NA	NA	NA	1.35E-04
Hydrogen Chloride	1.02E-03	NA	NA	NA	NA	NA	NA	1.02E-03
Hydrogen Fluorides	1.04E-04	NA	NA	NA	NA	NA	NA	1.04E-04
Nitric Acid	1.22E-03	NA	NA	NA	NA	NA	NA	1.22E-03
Nitrogen Dioxide	1.87E-03	NA	NA	NA	NA	NA	NA	1.87E-03
Particulate Matter	5.37E-04	NA	NA	NA	NA	NA	NA	5.37E-04
Sulfur Dioxide	1.77E-03	NA	NA	NA	NA	NA	NA	1.77E-03
Sulfuric Acid Mist	1.67E-02	NA	NA	NA	NA	NA	NA	1.67E-02
Total (Hazard Index)	1.20E-01	1.18E-04	1.66E-04	1.14E-05	1.10E-04	6.67E-06	9.82E-06	1.21E-01

Table 10-11

Child Hazard Index for the Inhalation, Ingestion, and Dermal Routes of Exposure for the Farmer Scenario

Pollutant	Inhalation	Vegetable Ingestion	Milk Ingestion	Beef Ingestion	Soil/Dust Ingestion	Fish Ingestion	Dermal Absorption	Total (Hazard Index)
	Exposure Routes							
ORGANICS								
Acetone	2.19E-17	NA	NA	NA	NA	NA	NA	2.19E-17
Acetonitrile	2.43E-13	4.61E-13	9.63E-19	1.62E-19	2.13E-16	3.17E-20	1.90E-17	7.04E-13
Acrylonitrile	5.53E-14	NA	NA	NA	NA	NA	NA	5.53E-14
Aldrin	1.01E-13	3.52E-12	1.00E-11	4.89E-13	4.51E-15	1.57E-17	4.03E-16	1.41E-11
Atrazine	1.12E-15	1.82E-16	4.22E-19	4.07E-20	2.02E-18	0.00E+00	1.81E-19	1.30E-15
Benzaldehyde	5.26E-12	1.98E-12	7.96E-16	1.26E-16	2.77E-14	5.21E-16	2.48E-15	7.28E-12
Benzene	1.59E-11	NA	NA	NA	NA	NA	NA	1.59E-11
Benzofuran	2.02E-10	8.33E-11	1.31E-13	1.70E-14	1.06E-12	9.00E-14	9.51E-14	2.87E-10
Benzoic Acid	6.37E-14	1.81E-14	1.49E-17	2.27E-18	3.35E-16	1.13E-17	3.00E-17	8.22E-14
Benzonitrile	3.03E-14	1.07E-14	5.00E-18	7.86E-19	1.60E-16	3.34E-18	1.43E-17	4.12E-14
Biphenyl	1.90E-10	NA	NA	NA	NA	NA	NA	1.90E-10
Bromomethane	2.96E-12	NA	NA	NA	NA	NA	NA	2.96E-12
Carbazole	9.70E-15	2.78E-15	1.64E-17	1.72E-18	5.11E-17	5.75E-18	4.57E-18	1.26E-14
Carbon Tetrachloride	5.10E-15	NA	NA	NA	NA	NA	NA	5.10E-15
Chlorobenzene	2.50E-11	NA	NA	NA	NA	NA	NA	2.50E-11
4-Chlorobiphenyl	1.20E-11	1.86E-12	4.86E-13	2.89E-14	6.30E-14	5.16E-15	5.65E-15	1.44E-11
4,4-Chlorobiphenyl	1.65E-13	2.08E-14	3.03E-14	1.61E-15	8.67E-16	2.37E-17	7.79E-17	2.18E-13
Chloroform	5.10E-16	NA	NA	NA	NA	NA	NA	5.10E-16
4-Chlorophenylmethylsulfone	4.73E-15	1.21E-15	3.02E-19	4.69E-20	1.34E-17	3.36E-19	1.20E-18	5.96E-15
4-Chlorophenylmethylsulfoxide	1.76E-14	4.73E-15	1.30E-18	1.99E-19	5.00E-17	1.24E-18	4.47E-18	2.24E-14
p,p-DDE	8.55E-11	3.17E-12	2.01E-11	1.05E-12	4.15E-13	2.87E-12	3.72E-14	1.13E-10
p,p-DDT	8.39E-15	4.58E-15	1.84E-14	9.21E-16	8.32E-17	6.00E-16	7.44E-18	3.30E-14
Dibenzofuran	NE	NE	NE	NE	NE	NE	NE	NE
Dichlorobenzenes (total)	2.27E-15	NA	NA	NA	NA	NA	NA	2.27E-15
1,1-Dichloroethene	6.93E-15	NA	NA	NA	NA	NA	NA	6.93E-15
1,2-Dichloroethene	4.92E-15	NA	NA	NA	NA	NA	NA	4.92E-15
1,2-Dichloropropane	3.24E-17	NA	NA	NA	NA	NA	NA	3.24E-17
Dieldrin	2.07E-14	2.89E-12	7.89E-14	3.99E-15	5.55E-16	4.02E-16	4.97E-17	3.00E-12
Diisopropyl Methylphosphonate	1.16E-14	2.69E-15	1.74E-18	2.60E-19	4.38E-17	1.58E-18	3.92E-18	1.43E-14
1,3-Dimethylbenzene	5.05E-13	6.05E-13	2.95E-15	3.20E-16	1.06E-14	1.17E-15	9.51E-16	1.13E-12
Dimethyldisulfide	3.17E-13	NA	NA	NA	NA	NA	NA	3.17E-13
Dimethyl Methylphosphonate	1.23E-12	6.54E-13	1.63E-19	2.67E-20	1.53E-16	3.85E-17	1.37E-17	1.88E-12
Dimethylphosphate	6.96E-14	2.27E-15	NE	NE	3.66E-16	NE	3.27E-17	7.22E-14
Dioxins/Furans (EPA TEFs)	1.55E-05	6.82E-07	8.23E-06	1.39E-06	7.67E-08	5.06E-08	6.86E-09	2.59E-05
Dithiane	9.27E-17	7.11E-17	6.65E-21	1.10E-21	4.88E-19	3.36E-21	4.36E-20	1.64E-16
Endrin	5.03E-14	6.00E-16	3.31E-16	2.12E-17	8.37E-17	9.47E-18	7.49E-18	5.14E-14
Ethylbenzene	3.43E-13	NA	NA	NA	NA	NA	NA	3.43E-13
Hexachlorobenzene	2.15E-12	5.62E-13	3.07E-13	1.64E-14	1.01E-14	1.24E-14	9.02E-16	3.06E-12
'exachlorocyclopentadiene	2.39E-12	1.97E-14	1.07E-15	5.74E-17	3.59E-17	2.24E-18	3.21E-18	2.41E-12
drin	1.93E-13	2.69E-12	2.93E-13	1.46E-14	1.02E-15	6.59E-15	9.09E-17	3.20E-12
hion	2.02E-15	1.42E-16	9.25E-19	1.12E-19	5.43E-18	0.00E+00	4.86E-19	2.17E-15

Table 10-11
(continued)

Methanol	2.20E-12	6.35E-12	1.75E-17	2.95E-18	6.17E-15	4.29E-17	5.52E-16	8.56E-12
Methyl Chloride	4.82E-12	NA	NA	NA	NA	NA	NA	4.82E-12
Methylene Chloride	5.90E-14	NA	NA	NA	NA	NA	NA	5.90E-14
4-Nitrophenol	8.55E-14	3.01E-14	7.90E-17	9.48E-18	4.50E-16	4.42E-17	4.02E-17	1.16E-13
PAHs								
Acenaphthalene	4.22E-12	1.99E-12	3.00E-14	2.31E-15	2.22E-14	3.57E-15	1.98E-15	6.26E-12
Acenaphthene	4.22E-12	9.27E-13	2.24E-14	1.82E-15	2.22E-14	1.39E-15	1.98E-15	5.19E-12
Benzo(a)pyrene	1.68E-12	6.54E-14	2.07E-12	1.02E-13	4.34E-15	9.50E-16	3.88E-16	3.92E-12
Chrysene	1.68E-12	1.61E-13	4.90E-13	2.47E-14	4.92E-15	2.40E-14	4.40E-16	2.39E-12
Dibenzo(a,h)anthracene	1.68E-12	7.85E-14	2.49E-12	1.22E-13	5.13E-15	5.39E-13	4.58E-16	4.91E-12
Fluoranthene	3.79E-12	5.75E-13	3.03E-13	1.59E-14	1.09E-14	NA	9.78E-16	4.70E-12
Fluorene	1.26E-12	3.68E-13	1.69E-14	1.16E-15	6.64E-15	1.49E-15	5.94E-16	1.66E-12
Phenanthrene	3.37E-12	3.94E-13	6.22E-14	3.50E-15	7.93E-15	6.67E-15	7.09E-16	3.84E-12
Pyrene	1.68E-12	2.04E-13	1.22E-13	6.33E-15	3.88E-15	5.47E-15	3.47E-16	2.02E-12
Parathion	5.59E-14	1.08E-16	2.04E-18	1.74E-19	2.50E-18	2.46E-19	2.23E-19	5.60E-14
Pentachlorobenzene	9.64E-13	5.08E-13	5.81E-14	3.33E-15	5.07E-15	NA	4.54E-16	1.54E-12
Phenol	1.41E-10	1.11E-11	6.74E-16	1.07E-16	2.40E-14	7.91E-17	2.15E-15	1.52E-10
Pyridine	1.49E-15	NA	NA	NA	NA	NA	NA	1.49E-15
Quinoline	6.04E-16	4.40E-16	1.71E-19	2.53E-20	3.18E-18	1.38E-19	2.84E-19	1.05E-15
Styrene	2.34E-12	NA	NA	NA	NA	NA	NA	2.34E-12
Supona	5.70E-14	1.32E-14	7.19E-17	8.06E-18	3.00E-16	3.20E-17	2.69E-17	7.07E-14
Tetrachlorobenzene	1.08E-12	1.28E-12	1.42E-14	9.82E-16	5.70E-15	NA	5.10E-16	2.39E-12
Tetrachloroethene	5.82E-15	NA	NA	NA	NA	NA	NA	5.82E-15
Toluene	4.43E-13	NA	NA	NA	NA	NA	NA	4.43E-13
Trichlorobenzene	5.71E-14	1.19E-15	5.11E-17	4.07E-18	4.51E-17	1.08E-17	4.03E-18	5.84E-14
Trichloroethene	1.13E-15	NA	NA	NA	NA	NA	NA	1.13E-15
Urea	4.38E-11	3.82E-09	8.12E-17	1.37E-17	2.30E-13	1.60E-15	2.04E-14	3.86E-09
Vapona	2.85E-14	1.15E-14	3.95E-18	6.29E-19	1.50E-16	2.49E-18	1.34E-17	4.02E-14
Vinyl Chloride	3.80E-11	NA	NA	NA	NA	NA	NA	3.80E-11
Xylene	1.18E-12	NA	NA	NA	NA	NA	NA	1.18E-12
INORGANICS								
Aluminum	3.28E-05	NA	NA	NA	NA	NE	NA	3.28E-05
Ammonia	6.98E-07	NA	NA	NA	NA	NA	NA	6.98E-07
Antimony	4.61E-06	2.05E-07	3.51E-08	6.21E-09	3.10E-08	NA	2.77E-09	4.89E-06
Arsenic	6.53E-05	4.40E-07	5.27E-06	2.79E-08	7.01E-08	3.37E-08	6.27E-09	7.11E-05
Barium	3.26E-05	1.57E-09	1.00E-09	7.16E-12	2.45E-10	NE	2.19E-11	3.26E-05
Beryllium	6.68E-05	8.93E-10	1.41E-12	2.47E-11	1.43E-10	3.46E-12	1.28E-11	6.68E-05
Boron	2.42E-05	NA	NA	NA	NA	NE	NA	2.42E-05
Cadmium	7.61E-06	NA	NA	NA	NA	8.53E-10	NA	7.61E-06
Calcium	3.91E-04	NA	NA	NA	NA	NA	NA	3.91E-04
Chromium (III)	1.74E-06	NA	NA	NA	NA	NA	NA	1.74E-06
Chromium (VI)	6.11E-07	NA	NA	NA	NA	6.47E-12	NA	6.11E-07
Cobalt	5.75E-05	NA	NA	NA	NA	1.71E-10	NA	5.75E-05
Copper	1.25E-03	1.64E-05	3.92E-05	6.36E-06	1.73E-06	2.66E-06	1.55E-07	1.32E-03
Cyanogen	1.13E-15	NA	NA	NA	NA	NA	NA	1.13E-15
Hydrogen Cyanide	4.70E-11	NA	NA	NA	NA	NA	NA	4.70E-11
Iron	1.74E-04	NA	NA	NA	NA	NE	NA	1.74E-04
Lead	9.72E-06	9.94E-08	4.57E-08	9.49E-10	1.57E-08	3.68E-09	1.41E-09	9.89E-06
Lithium	4.09E-06	NA	NA	NA	NA	NE	NA	4.09E-06

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Table 10-11
(continued)

Magnesium	8.63E-05	NA	NA	NA	NA	NE	NA	8.63E-05
Manganese	7.64E-05	NA	NA	NA	NA	NA	NA	7.64E-05
Mercury	4.30E-05	5.76E-07	4.14E-07	6.09E-06	6.47E-08	NA	5.78E-09	5.02E-05
Molybdenum	8.04E-06	NA	NA	NA	NA	NE	NA	8.04E-06
Nickel	1.04E-03	NA	NA	NA	NA	NA	NA	1.04E-03
Phosphate	NE	NA	NA	NA	NA	NA	NA	NE
Potassium	NE	NA	NA	NA	NA	NA	NA	NE
Selenium	1.67E-01	3.91E-04	3.04E-03	1.96E-04	5.99E-05	1.32E-06	5.36E-06	1.71E-01
Silicon	1.15E-02	NA	NA	NA	NA	NA	NA	1.15E-02
Silver	3.47E-02	4.69E-06	1.73E-04	5.51E-07	6.21E-07	2.60E-06	5.55E-08	3.49E-02
Sodium	NE	NA	NA	NA	NA	NA	NA	NE
Strontium	NE	NA	NA	NA	NA	NE	NA	NE
Thallium	3.37E-04	1.60E-05	5.62E-05	1.76E-05	2.58E-06	NA	2.31E-07	4.30E-04
Tin	1.47E-05	NA	NA	NA	NA	NE	NA	1.47E-05
Titanium	3.72E-08	NA	NA	NA	NA	NE	NA	3.72E-08
Vanadium	1.70E-04	NA	NA	NA	NA	8.31E-11	NA	1.70E-04
Yittrium	7.79E-08	NA	NA	NA	NA	NE	NA	7.79E-08
Zinc	7.39E-06	NA	NA	NA	NA	1.20E-09	NA	7.39E-06
CRITERIA POLLUTANTS/ ACID GASES								
Carbon Monoxide	3.02E-04	NA	NA	NA	NA	NA	NA	3.02E-04
Hydrogen Chloride	2.29E-03	NA	NA	NA	NA	NA	NA	2.29E-03
Hydrogen Fluorides	2.34E-04	NA	NA	NA	NA	NA	NA	2.34E-04
Nitric Acid	2.73E-03	NA	NA	NA	NA	NA	NA	2.73E-03
Nitrogen Dioxide	4.19E-03	NA	NA	NA	NA	NA	NA	4.19E-03
Particulate Matter	1.20E-03	NA	NA	NA	NA	NA	NA	1.20E-03
Sulfur Dioxide	3.97E-03	NA	NA	NA	NA	NA	NA	3.97E-03
Sulfuric Acid Mist	3.74E-02	NA	NA	NA	NA	NA	NA	3.74E-02
Total (Hazard Index)	2.70E-01	4.31E-04	3.32E-03	2.28E-04	6.51E-05	6.67E-06	5.82E-06	2.74E-01

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Table 10-12

Infant Hazard Index for the Inhalation and Mother's Milk Ingestion Routes of Exposure for the Resident-A Scenario

Pollutant	Inhalation	Mother's Milk Ingestion	Total (Hazard Index)
	Exposure Routes		
ORGANICS			
Acetone	4.09E-17	1.29E-17	5.39E-17
Acetonitrile	4.52E-13	3.60E-13	8.13E-13
Acrylonitrile	1.03E-13	5.17E-15	1.08E-13
Aldrin	1.88E-13	5.19E-12	5.37E-12
Atrazine	2.09E-15	5.43E-15	7.51E-15
Benzaldehyde	9.82E-12	2.60E-11	3.58E-11
Benzene	2.97E-11	1.12E-12	3.08E-11
Benzofuran	3.77E-10	9.77E-10	1.35E-09
Benzoic Acid	1.19E-13	3.10E-13	4.28E-13
Benzonitrile	5.66E-14	1.49E-13	2.06E-13
Biphenyl	3.55E-10	2.32E-11	3.78E-10
Bromomethane	5.52E-12	1.17E-12	6.69E-12
Carbazole	1.81E-14	4.65E-14	6.45E-14
Carbon Tetrachloride	9.50E-15	7.45E-15	1.70E-14
Chlorobenzene	4.66E-11	2.02E-13	4.68E-11
4-Chlorobiphenyl	2.23E-11	5.68E-11	7.91E-11
4,4-Chlorobiphenyl	3.07E-13	7.82E-13	1.09E-12
Chloroform	9.51E-16	8.26E-17	1.03E-15
4-Chlorophenylmethylsulfone	8.83E-15	2.31E-14	3.19E-14
4-Chlorophenylmethylsulfoxide	3.29E-14	8.57E-14	1.19E-13
p,p-DDE	1.59E-10	3.69E-10	5.28E-10
p,p-DDT	1.56E-14	3.76E-14	5.32E-14
Dibenzofuran	NE	NE	NE
Dichlorobenzenes (total)	4.24E-15	3.27E-17	4.27E-15
1,1-Dichloroethene	1.29E-14	5.09E-16	1.34E-14
1,2-Dichloroethene	9.17E-15	1.59E-16	9.33E-15
1,2-Dichloropropane	6.04E-17	7.42E-15	7.48E-15
Dieldrin	3.86E-14	1.16E-12	1.20E-12
Diisopropyl Methylphosphonate	2.16E-14	5.60E-14	7.76E-14
1,3-Dimethylbenzene	9.42E-13	9.68E-12	1.06E-11
Dimethyldisulfide	5.92E-13	1.46E-12	2.05E-12
Dimethyl Methylphosphonate	2.29E-12	6.29E-12	8.58E-12
Dimethylphosphate	1.30E-13	3.28E-13	4.58E-13
Dioxins/Furans (EPA TEFs)	2.89E-05	5.85E-04	6.14E-04
Dithiane	1.73E-16	4.86E-16	6.59E-16
Endrin	9.38E-14	8.07E-14	1.75E-13
Ethylbenzene	6.39E-13	4.91E-14	6.88E-13
Hexachlorobenzene	4.02E-12	2.32E-12	6.34E-12
Hexachlorocyclopentadiene	4.46E-12	3.67E-14	4.49E-12
Isodrin	3.60E-13	1.54E-12	1.90E-12
Malathion	3.78E-15	4.91E-15	8.69E-15
Methanol	4.10E-12	1.05E-11	1.46E-11
Methyl Chloride	8.98E-12	9.10E-13	9.89E-12
Methylene Chloride	1.10E-13	2.73E-14	1.37E-13
4-Nitrophenol	1.59E-13	4.11E-13	5.71E-13
PAHs			
Acenaphthalene	7.86E-12	2.03E-11	2.82E-11
Acenaphthene	7.86E-12	2.01E-11	2.79E-11
Benzo(a)pyrene	3.14E-12	8.01E-12	1.11E-11
Chrysene	3.14E-12	8.01E-12	1.12E-11
Dibenzo(a,h)anthracene	3.14E-12	8.89E-12	1.20E-11
Fluoranthene	7.08E-12	1.80E-11	2.51E-11
Fluorene	2.35E-12	6.03E-12	8.39E-12
Phenanthrene	6.28E-12	1.60E-11	2.22E-11
Pyrene	3.14E-12	7.98E-12	1.11E-11
Parathion	1.04E-13	2.26E-15	1.06E-13
Pentachlorobenzene	1.80E-12	1.05E-12	2.85E-12
Phenol	2.63E-10	1.74E-13	2.63E-10
Pyridine	2.78E-15	1.11E-13	1.14E-13
Quinoline	1.13E-15	2.98E-15	4.11E-15
Styrene	4.36E-12	8.21E-14	4.44E-12
Supona	1.06E-13	2.73E-13	3.79E-13

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Table 10-12
(continued)

Tetrachlorobenzene	2.02E-12	1.22E-12	3.24E-12
Tetrachloroethene	1.09E-14	6.52E-15	1.74E-14
Toluene	8.26E-13	6.82E-15	8.33E-13
Trichlorobenzene	1.07E-13	9.17E-15	1.16E-13
Trichloroethene	2.11E-15	1.36E-15	3.47E-15
Urea	8.16E-11	3.43E-09	3.51E-09
Vapona	5.32E-14	1.41E-13	1.95E-13
Vinyl Chloride	7.09E-11	1.26E-11	8.35E-11
Xylene	2.20E-12	5.45E-17	2.20E-12
INORGANICS			
Aluminum	6.13E-05	NE	6.13E-05
Ammonia	1.30E-06	NE	1.30E-06
Antimony	8.61E-06	NE	8.61E-06
Arsenic	1.22E-04	NE	1.22E-04
Barium	6.08E-05	NE	6.08E-05
Beryllium	1.25E-04	NE	1.25E-04
Boron	4.51E-05	NE	4.51E-05
Cadmium	1.42E-05	NE	1.42E-05
Calcium	7.29E-04	NE	7.29E-04
Chromium (III)	3.24E-06	NE	3.24E-06
Chromium (VI)	1.14E-06	NE	1.14E-06
Cobalt	1.07E-04	NE	1.07E-04
Copper	2.33E-03	NE	2.33E-03
Cyanogen	2.11E-15	NE	2.11E-15
Hydrogen Cyanide	8.76E-11	NE	8.76E-11
Iron	3.25E-04	NE	3.25E-04
Lead	1.81E-05	NE	1.81E-05
Lithium	7.62E-06	NE	7.62E-06
Magnesium	1.61E-04	NE	1.61E-04
Manganese	1.42E-04	NE	1.42E-04
Mercury	8.02E-05	NE	8.02E-05
Molybdenum	1.50E-05	NE	1.50E-05
Nickel	1.94E-03	NE	1.94E-03
Phosphate	NE	NE	NE
Potassium	NE	NE	NE
Selenium	3.12E-01	NE	3.12E-01
Silicon	2.15E-02	NE	2.15E-02
Silver	6.47E-02	NE	6.47E-02
Sodium	NE	NE	NE
Strontium	NE	NE	NE
Thallium	6.29E-04	NE	6.29E-04
Tin	2.75E-05	NE	2.75E-05
Titanium	6.93E-08	NE	6.93E-08
Vanadium	3.18E-04	NE	3.18E-04
Yittrium	1.45E-07	NE	1.45E-07
Zinc	1.38E-05	NE	1.38E-05
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	5.63E-04	NE	5.63E-04
Hydrogen Chloride	4.28E-03	NA	4.28E-03
Hydrogen Fluorides	4.36E-04	NA	4.36E-04
Nitric Acid	5.09E-03	NA	5.09E-03
Nitrogen Dioxide	7.81E-03	NA	7.81E-03
Particulate Matter	2.24E-03	NA	2.24E-03
Sulfur Dioxide	7.40E-03	NA	7.40E-03
Sulfuric Acid Mist	6.98E-02	NA	6.98E-02
Total (Hazard Index)	5.04E-01	5.85E-04	5.04E-01

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Table 10-13

Infant Hazard Index for the Inhalation and Mother's Milk Ingestion Routes of Exposure for the Resident-B Scenario

Pollutant	Exposure Routes: Inhalation	Mother's Milk Ingestion	Total (Hazard Index)
ORGANICS			
Acetone	6.41E-18	2.03E-18	8.44E-18
Acetonitrile	7.08E-14	2.75E-13	3.46E-13
Acrylonitrile	1.61E-14	8.10E-16	1.69E-14
Aldrin	2.94E-14	2.13E-12	2.16E-12
Atrazine	3.27E-16	9.05E-16	1.23E-15
Benzaldehyde	1.54E-12	5.57E-12	7.10E-12
Benzene	4.65E-12	1.75E-13	4.83E-12
Benzofuran	5.90E-11	1.83E-10	2.42E-10
Benzoic Acid	1.86E-14	6.02E-14	7.88E-14
Benzonitrile	8.86E-15	3.12E-14	4.01E-14
Biphenyl	5.55E-11	3.64E-12	5.92E-11
Bromomethane	8.64E-13	1.83E-13	1.05E-12
Carbazole	2.83E-15	8.18E-15	1.10E-14
Carbon Tetrachloride	1.49E-15	1.17E-15	2.65E-15
Chlorobenzene	7.30E-12	3.17E-14	7.33E-12
4-Chlorobiphenyl	3.49E-12	9.39E-12	1.29E-11
4,4-Chlorobiphenyl	4.81E-14	1.28E-13	1.76E-13
Chloroform	1.49E-16	1.29E-17	1.62E-16
4-Chlorophenylmethylsulfone	1.38E-15	4.60E-15	5.98E-15
4-Chlorophenylmethylsulfoxide	5.15E-15	1.67E-14	2.19E-14
p,p-DDE	2.50E-11	6.20E-11	8.70E-11
p,p-DDT	2.45E-15	7.04E-15	9.49E-15
Dibenzofuran	NE	NE	NE
Dichlorobenzenes (total)	6.64E-16	5.12E-18	6.69E-16
1,1-Dichloroethene	2.02E-15	7.97E-17	2.10E-15
1,2-Dichloroethene	1.44E-15	2.49E-17	1.46E-15
1,2-Dichloropropane	9.45E-18	1.16E-15	1.17E-15
Dieldrin	6.04E-15	1.03E-12	1.04E-12
Diisopropyl Methylphosphonate	3.38E-15	1.05E-14	1.39E-14
1,3-Dimethylbenzene	1.48E-13	1.72E-12	1.86E-12
Dimethyldisulfide	9.27E-14	2.28E-13	3.21E-13
Dimethyl Methylphosphonate	3.58E-13	1.64E-12	1.99E-12
Dimethylphosphate	2.03E-14	5.15E-14	7.18E-14
Dioxins/Furans (EPA TEFs)	4.52E-06	9.50E-05	9.95E-05
Dithiane	2.71E-17	1.40E-16	1.67E-16
Endrin	1.47E-14	1.27E-14	2.74E-14
Ethylbenzene	1.00E-13	7.69E-15	1.08E-13
Hexachlorobenzene	6.29E-13	4.03E-13	1.03E-12
Hexachlorocyclopentadiene	6.98E-13	1.15E-14	7.09E-13
Isodrin	5.64E-14	1.05E-12	1.11E-12
Malathion	5.91E-16	8.31E-16	1.42E-15
Methanol	6.41E-13	8.12E-12	8.76E-12
Methyl Chloride	1.41E-12	1.42E-13	1.55E-12
Methylene Chloride	1.72E-14	4.27E-15	2.15E-14
4-Nitrophenol	2.50E-14	7.49E-14	9.98E-14
PAHs			
Acenaphthalene	1.23E-12	3.76E-12	4.99E-12
Acenaphthene	1.23E-12	3.41E-12	4.65E-12
Benzo(a)pyrene	4.91E-13	1.32E-12	1.81E-12
Chrysene	4.91E-13	1.33E-12	1.82E-12
Dibenzo(a,h)anthracene	4.91E-13	2.21E-12	2.70E-12
Fluoranthene	1.11E-12	2.96E-12	4.07E-12
Fluorene	3.69E-13	1.05E-12	1.42E-12
Phenanthrene	9.84E-13	2.60E-12	3.58E-12
Pyrene	4.91E-13	1.30E-12	1.80E-12
Parathion	1.63E-14	3.87E-16	1.67E-14
Pentachlorobenzene	2.81E-13	1.97E-13	4.79E-13
Phenol	4.12E-11	5.59E-14	4.12E-11
Pyridine	4.35E-16	1.74E-14	1.79E-14
Quinoline	1.76E-16	6.44E-16	8.21E-16
Styrene	6.82E-13	1.28E-14	6.95E-13
Supona	1.67E-14	4.73E-14	6.40E-14

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Table 10-13
(continued)

Tetrachlorobenzene	3.17E-13	2.75E-13	5.91E-13
Tetrachloroethene	1.70E-15	1.02E-15	2.72E-15
Toluene	1.29E-13	1.07E-15	1.30E-13
Trichlorobenzene	1.67E-14	1.52E-15	1.82E-14
Trichloroethene	3.30E-16	2.14E-16	5.44E-16
Urea	1.28E-11	4.69E-09	4.71E-09
Vapona	8.33E-15	3.11E-14	3.94E-14
Vinyl Chloride	1.11E-11	1.97E-12	1.31E-11
Xylene	3.44E-13	8.54E-18	3.44E-13
INORGANICS			
Aluminum	9.59E-06	NE	9.59E-06
Ammonia	2.04E-07	NE	2.04E-07
Antimony	1.35E-06	NE	1.35E-06
Arsenic	1.91E-05	NE	1.91E-05
Barium	9.53E-06	NE	9.53E-06
Beryllium	1.95E-05	NE	1.95E-05
Boron	7.06E-06	NE	7.06E-06
Cadmium	2.22E-06	NE	2.22E-06
Calcium	1.14E-04	NE	1.14E-04
Chromium (III)	5.07E-07	NE	5.07E-07
Chromium (VI)	1.78E-07	NE	1.78E-07
Cobalt	1.68E-05	NE	1.68E-05
Copper	3.65E-04	NE	3.65E-04
Cyanogen	3.31E-16	NE	3.31E-16
Hydrogen Cyanide	1.37E-11	NE	1.37E-11
Iron	5.08E-05	NE	5.08E-05
Lead	2.84E-06	NE	2.84E-06
Lithium	1.19E-06	NE	1.19E-06
Magnesium	2.52E-05	NE	2.52E-05
Manganese	2.23E-05	NE	2.23E-05
Mercury	1.26E-05	NE	1.26E-05
Molybdenum	2.35E-06	NE	2.35E-06
Nickel	3.04E-04	NE	3.04E-04
Phosphate	NE	NE	NE
Potassium	NE	NE	NE
Selenium	4.89E-02	NE	4.89E-02
Silicon	3.37E-03	NE	3.37E-03
Silver	1.01E-02	NE	1.01E-02
Sodium	NE	NE	NE
Strontium	NE	NE	NE
Thallium	9.84E-05	NE	9.84E-05
Tin	4.30E-06	NE	4.30E-06
Titanium	1.09E-08	NE	1.09E-08
Vanadium	4.98E-05	NE	4.98E-05
Yittrium	2.28E-08	NE	2.28E-08
Zinc	2.16E-06	NE	2.16E-06
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	8.82E-05	NE	8.82E-05
Hydrogen Chloride	6.70E-04	NA	6.70E-04
Hydrogen Fluorides	6.83E-05	NA	6.83E-05
Nitric Acid	7.96E-04	NA	7.96E-04
Nitrogen Dioxide	1.22E-03	NA	1.22E-03
Particulate Matter	3.51E-04	NA	3.51E-04
Sulfur Dioxide	1.16E-03	NA	1.16E-03
Sulfuric Acid Mist	1.09E-02	NA	1.09E-02
Total (Hazard Index)	7.89E-02	9.50E-05	7.90E-02

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Table 10-14

Infant Hazard Index for the Inhalation and Mother's Milk Ingestion Routes of Exposure for the Farmer Scenario

Pollutant	Exposure Routes: Inhalation	Exposure Routes: Mother's Milk Ingestion	Exposure Routes: Total (Hazard Index)
ORGANICS			
Acetone	1.44E-17	4.54E-18	1.89E-17
Acetonitrile	1.59E-13	8.47E-13	1.01E-12
Acrylonitrile	3.62E-14	1.81E-15	3.80E-14
Aldrin	6.60E-14	1.44E-11	1.44E-11
Atrazine	7.33E-16	2.16E-15	2.89E-15
Benzaldehyde	3.45E-12	1.19E-11	1.54E-11
Benzene	1.04E-11	3.93E-13	1.08E-11
Benzofuran	1.32E-10	4.69E-10	6.02E-10
Benzoic Acid	4.17E-14	1.34E-13	1.76E-13
Benzonitrile	1.98E-14	6.74E-14	8.73E-14
Biphenyl	1.24E-10	8.15E-12	1.33E-10
Bromomethane	1.94E-12	4.10E-13	2.35E-12
Carbazole	6.35E-15	2.05E-14	2.68E-14
Carbon Tetrachloride	3.34E-15	2.61E-15	5.95E-15
Chlorobenzene	1.63E-11	7.09E-14	1.64E-11
4-Chlorobiphenyl	7.83E-12	2.29E-11	3.08E-11
4,4-Chlorobiphenyl	1.08E-13	3.24E-13	4.32E-13
Chloroform	3.34E-16	2.90E-17	3.63E-16
4-Chlorophenylmethylsulfone	3.10E-15	9.74E-15	1.28E-14
4-Chlorophenylmethylsulfoxide	1.15E-14	3.66E-14	4.82E-14
p,p-DDE	5.59E-11	1.47E-10	2.03E-10
p,p-DDT	5.49E-15	2.23E-14	2.78E-14
Dibenzofuran	NE	NE	NE
Dichlorobenzenes (total)	1.49E-15	1.15E-17	1.50E-15
1,1-Dichloroethene	4.54E-15	1.79E-16	4.72E-15
1,2-Dichloroethene	3.22E-15	5.59E-17	3.27E-15
1,2-Dichloropropane	2.12E-17	2.60E-15	2.62E-15
Dieldrin	1.35E-14	5.12E-12	5.14E-12
Diisopropyl Methylphosphonate	7.58E-15	2.34E-14	3.10E-14
1,3-Dimethylbenzene	3.31E-13	4.31E-12	4.64E-12
Dimethyldisulfide	2.08E-13	5.11E-13	7.19E-13
Dimethyl Methylphosphonate	8.03E-13	3.11E-12	3.91E-12
Dimethylphosphate	4.55E-14	1.17E-13	1.62E-13
Dioxins/Furans (EPA TEFs)	1.01E-05	2.61E-04	2.71E-04
Dithiane	6.07E-17	2.72E-16	3.32E-16
Endrin	3.29E-14	2.90E-14	6.19E-14
Ethylbenzene	2.24E-13	1.72E-14	2.41E-13
Hexachlorobenzene	1.41E-12	1.06E-12	2.47E-12
Hexachlorocyclopentadiene	1.56E-12	4.52E-14	1.61E-12
Isodrin	1.26E-13	5.09E-12	5.21E-12
Malathion	1.32E-15	1.92E-15	3.24E-15
Methanol	1.44E-12	1.27E-11	1.42E-11
Methyl Chloride	3.15E-12	3.19E-13	3.47E-12
Methylene Chloride	3.86E-14	9.58E-15	4.82E-14
4-Nitrophenol	5.59E-14	1.90E-13	2.46E-13
PAHs			
Acenaphthalene	2.76E-12	1.02E-11	1.30E-11
Acenaphthene	2.76E-12	8.43E-12	1.12E-11
Benzo(a)pyrene	1.10E-12	4.29E-12	5.39E-12
Chrysene	1.10E-12	3.38E-12	4.49E-12
Dibenzo(a,h)anthracene	1.10E-12	5.47E-12	6.58E-12
Fluoranthene	2.48E-12	7.34E-12	9.82E-12
Fluorene	8.26E-13	2.69E-12	3.51E-12
Phenanthrene	2.20E-12	6.18E-12	8.39E-12
Pyrene	1.10E-12	3.17E-12	4.27E-12
Parathion	3.66E-14	9.56E-16	3.75E-14
Pentachlorobenzene	6.31E-13	5.56E-13	1.19E-12
Phenol	9.23E-11	1.85E-13	9.25E-11
Pyridine	9.74E-16	3.91E-14	4.01E-14
Quinoline	3.95E-16	1.73E-15	2.12E-15
Styrene	1.53E-12	2.88E-14	1.56E-12
Supona	3.73E-14	1.15E-13	1.52E-13

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Table 10-14
(continued)

Tetrachlorobenzene	7.09E-13	8.89E-13	1.60E-12
Tetrachloroethene	3.81E-15	2.29E-15	6.09E-15
Toluene	2.90E-13	2.39E-15	2.92E-13
Trichlorobenzene	3.74E-14	3.60E-15	4.10E-14
Trichloroethene	7.40E-16	4.79E-16	1.22E-15
Urea	2.86E-11	6.59E-09	6.62E-09
Vapona	1.87E-14	6.58E-14	8.45E-14
Vinyl Chloride	2.49E-11	4.42E-12	2.93E-11
Xylene	7.72E-13	1.91E-17	7.72E-13
INORGANICS			
Aluminum	2.15E-05	NE	2.15E-05
Ammonia	4.57E-07	NE	4.57E-07
Antimony	3.02E-06	NE	3.02E-06
Arsenic	4.27E-05	NE	4.27E-05
Barium	2.13E-05	NE	2.13E-05
Beryllium	4.37E-05	NE	4.37E-05
Boron	1.58E-05	NE	1.58E-05
Cadmium	4.98E-06	NE	4.98E-06
Calcium	2.56E-04	NE	2.56E-04
Chromium (III)	1.14E-06	NE	1.14E-06
Chromium (VI)	4.00E-07	NE	4.00E-07
Cobalt	3.76E-05	NE	3.76E-05
Copper	8.17E-04	NE	8.17E-04
Cyanogen	7.42E-16	NE	7.42E-16
Hydrogen Cyanide	3.07E-11	NE	3.07E-11
Iron	1.14E-04	NE	1.14E-04
Lead	6.36E-06	NE	6.36E-06
Lithium	2.68E-06	NE	2.68E-06
Magnesium	5.65E-05	NE	5.65E-05
Manganese	5.00E-05	NE	5.00E-05
Mercury	2.81E-05	NE	2.81E-05
Molybdenum	5.26E-06	NE	5.26E-06
Nickel	6.82E-04	NE	6.82E-04
Phosphate	NE	NE	NE
Potassium	NE	NE	NE
Selenium	1.10E-01	NE	1.10E-01
Silicon	7.55E-03	NE	7.55E-03
Silver	2.27E-02	NE	2.27E-02
Sodium	NE	NE	NE
Strontium	NE	NE	NE
Thallium	2.21E-04	NE	2.21E-04
Tin	9.64E-06	NE	9.64E-06
Titanium	2.43E-08	NE	2.43E-08
Vanadium	1.12E-04	NE	1.12E-04
Yittrium	5.10E-08	NE	5.10E-08
Zinc	4.83E-06	NE	4.83E-06
CRITERIA POLLUTANTS/ ACID GASES			
Carbon Monoxide	1.98E-04	NE	1.98E-04
Hydrogen Chloride	1.50E-03	NA	1.50E-03
Hydrogen Fluorides	1.53E-04	NA	1.53E-04
Nitric Acid	1.78E-03	NA	1.78E-03
Nitrogen Dioxide	2.74E-03	NA	2.74E-03
Particulate Matter	7.87E-04	NA	7.87E-04
Sulfur Dioxide	2.60E-03	NA	2.60E-03
Sulfuric Acid Mist	2.45E-02	NA	2.45E-02
Total (Hazard Index)	1.77E-01	2.61E-04	1.77E-01

Table 10-15

Distribution of Carcinogenic Risk by Pathway, as a Percent of Total Risk, for all Scenarios (Base Case Emissions Rates)

Route of Exposure	Resident-A	Resident-B	Farmer	Worker
Adult				
Inhalation	NA	NA	NA	99.1
Ingestion	0.5	2.7	5.1	0.4
Vegetable	0.2	0.3	0.3	NA
Milk	0.1	0.5	3.9	NA
Beef	<0.01	0.01	0.1	NA
Soil/Dust	0.1	0.9	0.2	0.4
Fish	0.2	1.1	0.05	NA
Dermal	<.01	0.4	0.1	0.6
Child				
Inhalation	55.1	53.2	50.3	NA
Ingestion	0.2	1.1	2.1	NA
Vegetables	0.02	0.04	0.05	NA
Milk	0.04	0.2	1.8	NA
Beef	<.01	<.01	0.02	NA
Soil/Dust	0.1	0.6	0.2	NA
Fish	0.03	0.2	0.1	NA
Dermal	0.01	0.05	0.02	NA
Infant				
Inhalation	36.1	34.8	32.9	NA
Breast Milk	8.2	8.2	9.5	NA
TOTAL RISK	1.54E-08	2.50E-09	5.92E-10	7.64E-10

NA = Not applicable

Table 10-16

Hazard Index Values For Adults, Children, and Infants in the Four Exposure Scenarios Under Base Case Emissions Conditions

Exposure Scenario	Total Hazard Index		
	Adult	Child	Infant
Resident-A	3.1E-01	7.7E-01	5.0E-01
Resident-B	5.4E-02	1.2E-01	7.9E-02
Farmer	1.2E-01	2.7E-01	1.8E-01
Worker	3.4E-02	NA	NA

NA = Not applicable

SECTION 10

CITED REFERENCES

Ebasco Services, Inc. 1990. Final Human Health Exposure Assessment for Rocky Mountain Arsenal, Volume IV, Preliminary Pollutant Limit Value (PPLV) Methodology. Contract No. DAAA15-88-D-0024.

EPA (U.S. Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A. Interim Final. Office of Solid Waste and Emergency Response. OSWER Directive 9285.701A. EPA/540/1-89/002.

Woodward-Clyde Consultants. 1990. Final Decision Document For The Interim Response Action, Basin F Liquid Treatment, Rocky Mountain Arsenal, Volume I - Text. May 1990. Version 3.2 Contract No. DAAA15-88-D-0022/0011.

SECTION 11

DISCUSSION OF RISKS

11.1 INTRODUCTION

The risk results (i.e., lifetime excess carcinogenic risk and hazard indices) presented in this report, as is true for all risk assessments, are relative or conditional estimates because, in part, they are based on a number of assumptions. These assumptions are developed when there is an absence of empirical or reliable scientific data about the toxicity of chemicals of concern and the degree of exposure of the individuals to those chemicals. In practice, the required assumptions are derived deliberately to overestimate the real (absolute) risk (i.e., they are "conservative"). As a consequence, the absolute risks reasonably can be expected to be lower than the relative risks, and, therefore, provide a factor of safety to the potentially exposed individuals.

11.2 UNCERTAINTY ANALYSIS

The goal of an analysis of uncertainties is to provide the appropriate decision makers (i.e., risk managers) and the public with a discussion of the range of key assumptions and site-related variables that significantly influence the estimate of risk. Only with this additional information can the decision makers and the public have confidence that the potential health risks associated with operating the SQI have been addressed.

11.2.1 Toxicity-Related Assumptions

For a risk to exist, both exposure to the pollutants of concern and toxicity at the predicted exposure levels must exist. The toxicological uncertainties primarily relate to the methodology by which both carcinogenic and noncarcinogenic criteria are developed.

Although there is evidence to suggest some carcinogens may exhibit thresholds, the no-threshold theory of chemical carcinogenesis assumes there is no "safe" level (i.e., threshold) of exposure to any pollutant shown or suspected to cause cancer (an uncertainty). This implies that exposure to even a single molecule of a chemical may be associated with a finite risk, however small. The assumption is that even if relatively large doses of a pollutant were required to cause cancer in laboratory animals, (i.e., much higher than a person would ever likely be exposed to over a lifetime), these exposure doses can be linearly extrapolated downward many orders of magnitude to estimate slope factors for humans. The slope factor is used to estimate an upper bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a carcinogen. The assumptions and methodology of determining human cancer slope factors, therefore, likely result in an underestimate of actual cancer risk.

With respect to noncarcinogenic effects, there is assumed to be a defined level of exposure to a pollutant that can be tolerated by an individual without the occurrence of an adverse effect (i.e., a "threshold"). The approach is to identify a subthreshold exposure level that will be protective of the most sensitive individuals in the population (i.e., the reference dose, RfD). As this level can only be estimated from animal studies or limited human toxicity data, the RfD incorporates uncertainty factors anywhere from one to five orders of magnitude, which reflects the degree of extrapolation used in the derivation (EPA, 1989a).

The influence of specific uncertainties on the risk results are discussed in detail in the "Sensitivity Analysis" (Section 11.3) with respect to those chemicals that had the greatest effect on risk.

11.2.2 Exposure-related Assumptions

In addition to toxicological criteria, the risk equation also requires an estimation of the dose that a hypothetical individual might receive either directly or indirectly from a source of emissions such as the proposed SQI. As discussed in earlier sections, composite exposure scenarios were developed to determine the extent of exposure, and ultimately the risk.

Although these exposure scenarios are based on a number of standard assumptions that are commonly agreed upon by the scientific and regulatory communities, there are uncertainties inherent in them, uncertainties that need to be discussed in relation to the risk results. Wherever possible, site specific factors are taken into consideration in estimating exposure to reduce the uncertainty as much as possible.

A number of assumptions were made in this risk assessment that overestimate exposure in areas where the limitations in the available data made more specific quantification difficult or impossible. It is inherent in these assumptions that the actual case would clearly result in reduced exposure and consequent risk. These conservative assumptions include the following:

- For routes of exposure other than direct inhalation, it was assumed that the maximum exposed individual stands outdoors 24 hours/day, 365 days/year for 70 years (i.e., the standard maximum exposed person). There were no modifying assumptions made about the person's daily and lifelong mobility, nor was there recognition of the likely protective shielding effect from living indoors.

- From a conservation-of-mass perspective, one would expect that a fraction of the pollutants emitted from the stack will be removed by the wet and dry deposition processes, thereby depleting the mass of pollutants in the air available for inhalation. Inhalation exposure was maximized in this risk assessment by assuming that the atmospheric pollutant concentrations resulting from stack emissions were not reduced by the wet and dry deposition phenomena. Likewise, it was assumed that the total mass of emitted pollutants was adsorbed to particulates available for wet and dry deposition. Effectively, this means that the total mass of stack emissions are available both for inhalation exposure and for exposure through indirect pathways as a result of wet or dry deposition. These assumptions greatly overestimate the amount of pollutants likely to be inhaled or ingested, and consequently, the health risk.

- The scavenging coefficients used in the calculation of wet deposition are generally based on research from industrial plants. The majority of the particles emitted from these facilities are sulfate aerosols. Sulfate aerosols have a great affinity for water so that coefficients based on these studies and, therefore, wet deposition would be overestimated.

- It was assumed that rainfall did not remove pollutants deposited by dry deposition from garden fruits, leaf vegetables, and cattle feed crops. Also, it was assumed that these edible crops were not washed before consumption. These assumptions resulted in higher calculated ingestion rates for deposited pollutants.

- For those chemicals for which degradation was not considered, the total 2-year pollutant loading of the incinerator was assumed to be deposited in the soil at the startup of incinerator operation. Therefore, exposure through the soil pathway during the lifetime exposure period for these contaminants was based on the maximum soil concentration resulting from 2 years of deposition.

The following assumptions that may underestimate risk were made:

- It was assumed that pollutants deposited by wet deposition (rainfall) do not adhere to aboveground portions of edible plant surfaces and, therefore, are not available for ingestion by the vegetable pathway. Although it is likely that a small amount remains on the plants as a result of wet deposition, it was assumed that this was more than compensated for by the assumption that rainfall does not wash off any pollutants deposited by dry deposition.

- It was assumed that total risk in a given exposure scenario is the sum of individual risks for each pollutant and exposure pathway, an accepted practice in risk assessment. Some recent research has suggested the possibility of synergistic effects among pollutants (i.e., the toxic effects of one pollutant being increased greatly because of simultaneous exposure to a different pollutant) beyond the simple additive effects of the two pollutants. However, the available data on this subject are not sufficient to predict the likelihood or magnitude of the increased toxicity potential, particularly at the low exposure concentrations associated with the incinerator, and with the large number of possible chemical interactions. Equally uncertain is the ability to predict the effects of antagonism on resultant risk. Antagonism is the phenomenon by which the toxicity of a chemical is reduced in the presence of another.

As is evident from this discussion, there were a number of assumptions made in each step of this risk assessment (contaminant selection, air modeling, emissions estimation, toxicity assessment, and exposure assessment), the inherent uncertainties of which tend to overestimate risk. Also, some assumptions were made that may underestimate risk. Based on a review of these uncertainties and their relative importance, it can be reasonably

concluded that the estimated risk results presented in this report represent an upperbound estimate of the lifetime carcinogenic risk and noncarcinogenic health effects to individuals under the scenarios of exposure, and further, that they overestimate the true or absolute risk.

11.3 SENSITIVITY ANALYSIS

This subsection discusses the specific parameter values that were observed to have the most significant influence on the risk results. The purpose of this analysis is to demonstrate quantitatively the range of risk results under specified conditions such that the risk managers, decision makers, and public can interpret the results as objectively as possible.

11.3.1 Emission Rates

The health risk associated with an incinerator in general is proportional to the rate at which pollutants are dispersed into the atmosphere. This subsection evaluates the effect on risk of the upperbound emission rates in comparison with the average expected emission rates. The average expected (base case) and reasonable worst case (sensitivity case) emission rates were presented in Section 5, Table 5-1. Base case emission rates were used to calculate the risks presented in Section 10 and, therefore, represent those risks associated with expected operating conditions. For purposes of comparison, the risks based on sensitivity case emission rates are presented in Tables 11-1 through 11-4, which are located at the end of this section. Sensitivity case emission rates were calculated for the inorganics, the criteria pollutants, and dioxins/furans. As discussed in detail in Section 5, there were insufficient data to determine sensitivity case emission rates for the remaining organics.

11.3.1.1 Carcinogenic Risk

As with the results under base case emissions, total lifetime carcinogenic risk ranged from one to two orders of magnitude less than the 1E-06 risk criterion considered as the "acceptable" risk level in the Final Decision Document (Woodward-Clyde, 1990). Resident-

A demonstrated the highest total lifetime risk (6.14E-08) of all the four scenarios (Table 11-1). Breast milk ingestion (infant) and inhalation (child) accounted for 32.6 percent and 40.4 percent, respectively, and overall the infant represented 59 percent of this risk (Table 11-2). The same distribution pattern of risk by pathway and subpopulation (i.e., infant and child) was observed for the Resident-B and Farmer scenarios, although the total risk estimates were lower (data not shown). The worker carcinogenic risk was primarily driven by inhalation (data not shown). Although Resident-A showed the highest risk in this analysis, the total value of 6.14E-08 is well below the level of concern.

11.3.1.2 Noncarcinogenic Risk

Noncarcinogenic hazard indices (HI) exceeded unity in two scenarios under sensitivity case emissions conditions (Table 11-3). Adult, child, and infant HI values in the Resident-A scenario were 1.8, 3.9, and 2.6, respectively. The HI for the child in the Farmer scenario also exceeded unity (1.4).

In situations where the hazard index exceeds 1.0, EPA (1989a) guidance recommends re-evaluation of the contribution of individual chemicals by toxicity endpoint and exposure pathway. A hazard index of 1.0 is generally considered by EPA (1989a) as a benchmark of concern for noncarcinogenic effects when evaluating large groups of chemicals with differing toxic endpoints across many exposure pathways. This benchmark approach conservatively assumes, for risk assessment purposes, that all noncarcinogenic effects are additive, which in fact, may not be true (e.g., the individual chemicals may be affecting different target organs and providing different adverse health effects). For initial assessment of noncarcinogenic health effects potential, this approach is useful, since, if the HI is less than 1, there is increased confidence in the conclusion that noncarcinogenic health effects are unlikely. However, it is justifiable from a scientific viewpoint to more carefully assess the actual toxic endpoints as well as other contributing factors when the HI exceeds unity.

An evaluation of the contributing exposure pathways and chemicals is summarized in Table 11-4. The distinguishing features of this analysis were the following:

- Inhalation was the major contributing exposure pathway for all subpopulations (>99% in all cases).

- Four substances were consistently responsible for elevating the HI (percent contribution to total hazard index) above unity in all cases:

  - barium (50%)
  - silver (29%)
  - selenium (12%)
  - sulfuric acid mist (5%)

For the following reasons, it is suggested that the excursions above unity of the hazard indices under sensitivity case emissions conditions are not of concern:

- In all cases, inhalation exposure to barium contributed approximately 50 percent to the hazard index in each scenario. To a lesser degree, but in a qualitatively similar manner, silver and selenium also contributed to these values. The sensitivity case emission rate for barium was calculated to be approximately 20,000 fold greater than its base case rate (refer to Appendix 5A). This was an extremely conservative and unlikely estimate for the worst case emission rates.

  Sensitivity emissions rates for barium and several other metals were based upon EPA Tier II guidance (EPA, 1989b). If expected emission rates for a single metal from a facility are below these values, EPA does not require more rigorous dispersion modeling and risk assessment. Therefore, the Tier II guidance values were assumed as the absolute worst case emission rates for all metals specified by EPA for which the Tier II values exceeded the maximum values based on the waste stream data and the average of all test burn runs (acceptable and unacceptable). The metals evaluated were antimony, barium, beryllium, cadmium, lead, mercury, silver, thallium. The maximum values for barium and silver from the test burn and waste stream values are the same order of magnitude as the base case. Generally, there will be an approximately linear relationship between hazard index and emission rate. Therefore, it can be anticipated that the hazard index would be substantially lower if more realistic worse case emissions rates had been used.

- Chronic inhalation reference doses were used to calculate the hazard quotients for all metals and organics, even though the true exposure duration for the SQI is one of a subchronic nature (i.e., less than 7 years). If one recalculates the hazard quotients with subchronic reference doses, which in themselves are still highly conservative, the hazard quotients will decrease by

at least one order of magnitude. Barium has a subchronic inhalation reference dose of 1E-03 mg/kg/day and a chronic reference dose is 1E-04 mg/kg/day (EPA, 1990). Therefore, under identical exposure conditions, the hazard quotient for barium would decrease by one order of magnitude. By the same rationale, selenium and silver inhalation RfDs, which were derived from occupational exposure limits (OELs) assuming a chronic inhalation exposure duration, also can justifiably be increased by an order of magnitude. Consequently, the hazard indices in all of the scenarios that exceeded one can be effectively reduced by an order of magnitude (refer to HI algorithm in toxicity assessment, Section 9) so that the expected range of hazard indices in Table 11-4 would be 0.14 to 0.40 instead of 1.4 to 4.0.

11.3.2 Adult Inhalation Carcinogenic Risk in Off-Site Exposure Scenarios

Adult inhalation carcinogenic risk was not addressed in the off-site exposure scenarios (Resident-A, Resident-B, and Farmer). The rationale for this exposure assumption was previously explained in Subsection 10.1.1. However, it was decided to evaluate this exposure pathway separately, under both base case and sensitivity case emissions conditions, so that this individual risk estimate could be discussed should the issue arise.

Table 11-5 summarizes the results, which were determined using the equivalent exposure assumptions, modeling parameters, and toxicity criteria employed in the estimation of inhalation carcinogenic risk for children and infants in the three off-site scenarios. The maximum adult inhalation carcinogenic risk calculated for the Resident-A scenario under base case and sensitivity case emissions conditions was 7.5E-09 and 2.2E-08, respectively. These relative risks are between one and two orders of magnitude less than the "acceptable" risk level of 1E-06 defined in the Final Decision Document (Woodward-Clyde, 1990). It is evident that even if these risks were to be added to the total lifetime risks calculated under the assumptions of the original scenarios, the resultant total risks would still be less than the level of concern.

11.4 CONCLUSIONS

Based on an analysis of the uncertainties and assumptions in the exposure assessment and on the results of the sensitivity analysis, it can be concluded with reasonable confidence that the SQI proposed to incinerate Basin F liquid waste at RMA poses neither a significant carcinogenic nor noncarcinogenic health risk to the most exposed public (off-site) or the most exposed worker (on-site).

Table 11-1

Comparison of Total Lifetime Carcinogenic Risk Estimated For the SQI Under Base Case and Sensitivity Case Emissions Conditions

Exposure Scenario	Carcinogenic Risk	
	Base Case	Sensitivity Case
Resident-A		
Adult	8.00E-11	3.15E-10
Child	8.51E-09	2.49E-08
Infant	6.81E-09	3.62E-08
Total	1.54E-08	6.14E-08
Resident-B		
Adult	6.88E-11	2.59E-10
Child	1.36E-09	3.98E-09
Infant	1.07E-09	5.78E-09
Total	2.50E-09	1.00E-08
Farmer		
Adult	3.08E-10	9.93E-10
Child	3.10E-09	9.08E-09
Infant	2.51E-09	1.46E-08
Total	5.92E-09	2.47E-08
Worker		
Adult	7.64E-10	2.24E-09

Table 11-2

Distribution of Carcinogenic Risk By Pathway For the Resident-A Scenario Under Sensitivity Case Emissions Conditions

Route of Exposure	Percent of Lifetime Carcinogenic Risk
Adult	
Inhalation	NA
Ingestion	0.5
Vegetable	0.2
Milk	0.05
Beef	<0.01
Soil/Dust	0.1
Fish	0.2
Dermal	<0.01
Child	
Inhalation	40.4
Ingestion	0.1
Vegetable	0.03
Milk	0.02
Beef	<0.01
Soil/Dust	0.06
Fish	0.03
Dermal	<0.01
Infant	
Inhalation	26.4
Breast Milk	32.6
Total Risk	6.14E-08

NA - Not applicable. Using assumptions discussed in Section 8, inhalation carcinogenic risk was not evaluated for the adult in any off-site exposure scenarios. Refer to Section 11.3.2 and Table 11-5 for a separate evaluation of this pathway.

Table 11-3

Noncarcinogenic Hazard Indices For the Four Exposure Scenarios Under Sensitivity Case Emissions Conditions

Exposure Scenario	Total Hazard Index
Resident-A	
Adult	1.75E+00
Child	3.95E+00
Infant	2.59E+00
Resident-B	
Adult	2.74E-01
Child	6.19E-01
Infant	4.06E-01
Farmer	
Adult	6.15E-01
Child	1.39E+00
Infant	9.10E-01
Worker	
Adult	1.76E-01

Table 11-4

Primary Contributing Factors To Hazard Indices Exceeding Unity Under Sensitivity Case Emissions Conditions

Exposure[a] Scenario	Total Hazard Index	Exposure By Pathway			Exposure By Chemical[b]		
		Pathway	Hazard Quotient	% Total HI	Chemical	Hazard Quotient	% Total HI
Resident-A							
Adult	1.75	Inhalation	1.75	100	Barium	0.86	49
					Selenium	0.21	12
					Silver	0.50	29
					Sulfuric Acid	0.08	5
Child	3.95	Inhalation	3.95	100	Barium	1.94	49
					Selenium	0.48	12
					Silver	1.13	29
					Sulfuric Acid	0.18	5
Infant	2.59	Inhalation	2.58	99.6	Barium	1.27	49
					Selenium	0.31	12
					Silver	0.74	29
					Sulfuric Acid	0.12	5
Farmer							
Child	1.39	Inhalation	1.38	99.2	Barium	0.68	49
					Selenium	0.17	12
					Silver	0.40	29
					Sulfuric Acid	0.06	4

[a]Hazard indices exceeded unity only in the Resident A and Farmer scenarios, as enumerated below.
[b]For all chemicals, inhalation exposure represented greater than 99% of the total hazard index.

Table 11-5

Inhalation[a] Carcinogenic Risk For Adult Resident, Farmers, and Workers Under Base Case and Sensitivity Case Emissions

Exposure Scenario	Inhalation Carcinogenic Risk	
	Base Case Emissions	Sensitivity Case Emissions
Adult Resident-A	7.52E-09	2.19E-08
Adult Resident-B	1.18E-09	3.44E-09
Adult Farmer	2.64E-09	7.70E-09
Worker	7.56E-10	2.21E-09

[a]Exposure duration is adjusted for 2 years at average daily exposures.

SECTION 11

CITED REFERENCES

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